

Universidade do Minho
Escola de Economia e Gestão

Izzat Ibrahim Ramadan **Three Essays on Financial Literacy and Financial Behavior**

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Financial Behavior**

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Universidade do Minho
Escola de Economia e Gestão

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**Three Essays on Financial Literacy and
Financial Behavior**

Ph.D. Thesis in Business Administration

Work developed under the supervision of
Manuel Jose Da Rocha Armada
Cristiana Cerqueira Leal

STATEMENT OF INTEGRITY

I hereby declare having conducted my thesis with integrity. I confirm that I have not used plagiarism or any form of falsification of results in the process of the thesis elaboration. I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Universidade do Minho

Escola de Economia e Gestão

Ph.D. in Business Administration

September, 2018

Name: **Izzat Ibrahim Ramadan**

Signature:

A handwritten signature in black ink, enclosed within a large, hand-drawn oval. The signature is stylized and appears to be the initials 'IIR' followed by a flourish.

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"To my father and mother"

ABSTRACT

The lack of consistent evidence of a positive effect of financial literacy on financial behavior can be attributed to omitted variable bias, measurement error and reverse causality of financial literacy. This thesis presents insights to solve for the previously mentioned problems. Our study constitutes three papers on financial literacy and financial behavior. In the first study, we present an inter-temporal consumption model that integrates the effect of family ties on the individual's choice level of investment in financial literacy. We posit that individuals with strong family ties tend to seek financial advice from their family network instead of improving their financial decision-making by investing in financial literacy. This allows individuals with strong family ties to substitute the costs of investing in financial literacy with consumption or saving. The result is a sub-optimal financial literacy level for individuals with strong family ties as opposed to ones with weaker family ties. Furthermore, based on the assumption that a higher financial literacy level allows the individual to make better financial decisions and thus earn a higher return on savings, individuals with strong family ties will have a lower return on savings, which in turn requires them to optimally save more than those with weaker family ties. The model drives our empirical approach to the analysis of the effect of family ties on financial literacy, and the joint effect of financial literacy and family ties on financial behavior. Using microeconomic panel data from SHARE WAVE 5, 6 and WAVE 3 SHARELIFE, we find strong support for the model's predictions. After controlling for endogeneity, a strong level of family ties shows a significant negative effect on financial literacy. In addition, the initial level of financial literacy positively influences the current level of financial literacy. After applying IV regressions and Generalized Method of Moments (GMM), the effect of the initial level of financial literacy weakens in its effect on the current level of financial literacy. On the other hand, family ties show a significant negative effect on saving, investment in complex financial instruments, wealth and debt accumulation. In compliance with prior research, there is a positive effect of financial literacy on financial behavior. However, the effect weakens once we introduce family ties to our empirical model. After using IV regressions and GMM, the effect of financial literacy increases in its effect on our financial behavior proxies. These findings show that financial literacy is not the main determinant of financial behavior and suggest new implementations of financial education programs that address cultural differences if needed.

In our second paper, we present a comparative cross-region study that explains individual financial literacy level through demographic, psychological and cultural factors, where cultural and psychological factors are introduced for the first time in a financial literacy study to control for omitted variable bias. We produce a comprehensive survey that collects all these factors and is applied to 600 individuals that can be subdivided into three regions: Arabic, Germanic and Latin Europe (nine countries). The data is analyzed using OLS regression with country fixed effects, Instrumental Variables Regression, Generalized Method of Moments (GMM), Principal Component Analysis (PCA), and Principal Com-

ponent Regression (PCR). The regression findings show that financial literacy is positively associated with numeracy, financial socialization, Germanic countries and the psychological trait of confidence. In addition, financial literacy is negatively associated with the cultural traits of family ties and religiosity; the psychological trait of impatience, increased age and being female. Moreover, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. Based on AI techniques using Regression Trees, Random Forest and Quantile Regression Forests, we find that financial literacy is mostly determined by geographic region, numeracy, impatience, confidence, financial socialization by parents, family ties and religiosity. These findings contribute to knowledge by suggesting new implementations of financial education program as an attempt to improve the effectiveness of financial literacy on financial behavior. These findings can be taken into consideration in constructing financial education programs that can be targeted towards focus groups based on gender, country, age, level of religiosity, family ties, impatience and confidence.

In our third paper, we present a comparative cross-region study that explains individual five proxy measures of financial behavior level through financial literacy, financial socialization by parents, numeracy, demographic, psychological (impatience, risk-taking and confidence) and cultural factors (family ties and religiosity). Our five proxies of financial behavior are active savings, budgeting, punctual debt payment, stock market participation and retirement saving. We produce a query that aggregates all these factors and is applied to 600 individuals from Arabic countries (300 responses), Germanic countries (149 responses) and Latin European countries (151 responses). The data is analyzed using OLS regression with country fixed effects, IV regression, GMM, PCA and PCR. Moreover, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Classification Trees, Random Forest and Quantile Regression Forests. We find that financial behavior is mostly determined by financial socialization by parents, impatience, confidence, risk-taking, financial literacy, numeracy, family ties and religiosity. Our findings show that financial literacy is not always the main determinant of financial behavior. The effect of numeracy, financial socialization, family ties, religiosity, impatience, confidence on financial behavior suggest that relying solely on financial literacy is not a solution to improve individual financial behavior. These findings suggest the need to identify new methods to improve financial behavior. This can be done using financial education programs and public policies that integrate psychological and cultural differences. In addition, the inability of financial education program to consistently improve financial behavior may result in new public policies that help the individual to attain financial well-being.

Index terms— Financial Literacy, Financial Behavior, Religiosity, Family Ties

RESUMO

A presente tese consiste em três estudos sobre a relação entre a literacia e o comportamento financeiro e procura apresentar soluções para os problemas previamente mencionados. O primeiro estudo apresenta um modelo intertemporal de consumo que considera o efeito dos laços familiares na escolha do nível individual de investimento em literacia financeira. É sugerido que, por forma a melhorarem as suas decisões financeiras, indivíduos com laços familiares mais fortes são mais propensos a procurar aconselhamento financeiro junto dos seus familiares, ao invés de investirem em literacia financeira. Isto permite que estes indivíduos substituam os custos do investimento em literacia financeira por consumo de outros bens ou poupança. O resultado é um nível sub-ótimo de literacia financeira para os indivíduos com laços familiares mais fortes. Com base no pressuposto de que a uma maior literacia financeira estão associadas melhores decisões financeiras e conseqüentemente um maior retorno financeiro da poupança é ainda possível conjecturar que os indivíduos com laços familiares mais fortes vão obter menores retornos nas suas poupanças, o que requer que, para obterem um mesmo nível de consumo futuro, os mesmos poupem mais do que os indivíduos com laços familiares mais fracos. Este modelo guia a abordagem empírica efetuada para analisar o efeito dos laços familiares na literacia financeira e o efeito conjunto da literacia financeira e dos laços familiares nas decisões financeiras. Com base em dados microeconómicos das bases de dados SHARE WAVE 5, 6 e WAVE 3 SHARELIFE, é encontrado um forte suporte empírico para as previsões do modelo. Controlando para a endogeneidade, a um nível alto de laços familiares está associada uma menor literacia financeira. Adicionalmente, o nível inicial de literacia financeira revela influenciar positivamente o nível final da mesma. Contudo, este efeito é mais ténue quando se estimam regressões com variáveis instrumentais e através do método generalizado dos momentos. Os laços familiares também revelam exercer um efeito negativo na poupança, no investimento em produtos financeiros complexos, na riqueza e na acumulação de dívida. Em linha com os resultados previamente encontrados na literatura, é encontrado um efeito positivo da literacia financeira no comportamento financeiro. Este efeito torna-se mais ténue quando se controla para os laços familiares e mais robusto quando se utilizam variáveis instrumentais ou o método generalizado dos momentos.

O segundo estudo consiste numa análise comparativa entre regiões que procura explicar a literacia financeira individual através de fatores demográficos, psicológicos e culturais, e onde os fatores psicológicos e culturais são introduzidos pela primeira vez na literatura como forma de amenizar o problema do enviesamento por variáveis omitidas. Foi desenhado um inquérito com o propósito de recolher informação relativa a todos esses fatores, tendo o mesmo sido implementado a 600 indivíduos de 9 países e três regiões: Árabe, Germânica e a Europa Latina. Os dados são analisados através de regressões OLS com controlo para efeitos fixos ao nível dos países, de regressões com variáveis instrumentais, de regressões estimadas pelo método generalizado dos momentos, da análise de componentes

principais e da regressão de componentes principais. Os resultados revelam que a literacia financeira está positivamente associada à numeracia, à socialização financeira, à proveniência de um país Germânico e à característica psicológica confiança. A literacia financeira está negativamente associada aos fatores culturais laços familiares e religiosidade, ao fator psicológico impaciência, à idade e ao ser do sexo feminino. Neste estudo são ainda aplicadas técnicas de inteligência artificial baseadas em algoritmos de machine learning como árvores de regressão, floresta aleatória e florestas de regressão por quantis. Os resultados obtidos através das técnicas de inteligência artificial demonstram que a literacia financeira é maioritariamente determinada pela região geográfica, a numeracia, a impaciência, a confiança, a socialização financeira com os pais, os laços familiares e a religiosidade. Estes resultados sugerem que devem ser implementados novos programas educacionais para diferentes grupos com base no género, país de origem, nível de religiosidade, laços familiares, impaciência e confiança dos indivíduos por forma a melhorar a eficiência dos mesmos.

No terceiro estudo, é efetuada uma análise comparativa entre regiões que procura explicar cinco medidas aproximadas do comportamento financeiro através da literacia financeira, socialização financeira pelos pais, numeracia, fatores demográficos, fatores psicológicos, e fatores culturais. As cinco proxies para o comportamento financeiro são a poupança, a orçamentação, a pontualidade nos pagamentos de dívida, a participação no mercado de ações e a poupança para a reforma. Foi elaborado um inquérito que agrega os cinco fatores referidos e implementado junto de 600 indivíduos de países arábicos (300 respostas), germânicos (149 respostas) e sul-europeus (151 respostas). Os dados são analisados através de regressões OLS com controlos para efeitos fixos ao nível do país, regressões com variáveis instrumentais, o método generalizado dos momentos, a análise de componentes principais e a regressão de componentes principais, sendo ainda aplicados algoritmos de machine learning como as árvores de regressão, a floresta aleatória e a floresta de regressão por quantis. Os resultados revelam que o comportamento financeiro é maioritariamente determinado pela socialização financeira com os pais, a impaciência, a confiança, a aversão ao risco, a literacia financeira, a numeracia, os laços familiares e a religiosidade. Estes revelam ainda que a literacia financeira é o mais importante determinante do comportamento financeiro. O efeito da numeracia, da socialização financeira, dos laços familiares, da religiosidade, da impaciência e da confiança no comportamento financeiro sugerem, no entanto, que o foco exclusivo na literacia financeira não é a estratégia mais adequada para a melhoria do comportamento financeiro dos indivíduos. Consequentemente os resultados exacerbam a necessidade de encontrar novos métodos de melhoria do comportamento financeiro, o que pode ser feito através de programas educacionais e políticas públicas que tenham em conta diferenças psicológicas e culturais entre os indivíduos.

Index terms— Literacia Financeira, Comportamento Financeiro, Religiosidade, Laços Familiares

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LIST OF ACRONYMS

2SLS: Two-Stage Least Squares

AI: Artificial Intelligence

CT: Classification Trees

GMM: Generalized Method of Moments

IV: Instrumental Variables

IV Reg: Instrumental Variables Regression

ML: Machine Learning

MSE: Mean Squared Error

OLS: Ordinary Least Squares

PCA: Principal Component Analysis

PCR: Principal Component Regression

PSM: Propensity Score Matching

QRF: Quantile Regression Forests

RF: Random Forest

RT: Regression Trees

CHAPTER 1

INTRODUCTION

Individuals are facing a financial environment that has become dramatically riskier with the presence of more complex financial products and services such as credit facilities and retirement plans (Woodward and Hall, 2012). While these financial products such as credit facilities and retirement plans are supposed to improve individual financial wellness and lifestyle, individuals experience major increases in bankruptcy in countries that change their retirement systems (White, 2009). McKenzie and Liersch (2011) explain how the decrease in generosity level of social security systems and retirement plans, forces individuals to learn more about how much to save, invest and make lump-sum payouts through retirement.

As a remedy for these changes in the financial system, an increase in financial education and financial literacy programs are prescribed by researchers and policymakers in order to improve individual's financial behavior. Financial literacy is defined as the ability to use skills and knowledge in order to effectively manage a person's financial resources for a lifetime of financial security (Mandell, 2009). On the other hand, financial behavior is defined as any human behavior that is relevant to money management. Common financial behaviors include cash, credit, and saving behaviors. According to Xiao (2008), good financial behavior results in good financial wellness.

To better understand if financial literacy and financial education programs are effective in improving financial behavior, we first need to study the determinants of financial literacy, and if financial literacy is an important determinant of financial behavior in comparison with other factors. According to global surveys, financial literacy levels vary by gender in favor of males (Lusardi and Mitchell, 2011c; Van Rooij et al., 2011b; Klapper et al., 2015), age (Lachance and Choquette-Bernier, 2004; Lusardi et al., 2017), experience (Agarwal et al., 2009), education (Lusardi and Mitchell, 2011b; Gill and Prowse, 2016; Lusardi et al., 2010) and parental education (Mahdavi and Horton, 2014; Grohmann et al., 2015). In finding the effect of financial literacy on financial behavior, studies have found that financially literate people are associated with wealth accumulation (Klapper et al., 2015; Lusardi and Mitchell, 2011c). Other than financial literacy, social contributors to financial behavior are numeracy (Almenberg and Widmark, 2011; Banks et al., 2011; Estrada-Mejia et al., 2016), financial socialization by parents, parental background, quality of education, economics in school and academic performance (Gudmunson and Danes, 2011; Grohmann et al., 2015).

With an empirical evidence of an effect of financial literacy on financial behavior, proponents of financial education programs believe that individuals will benefit from finance courses to improve their financial behavior. However, Gneezy et al. (2011) argue that the effects can be weak sometimes. According to Hastings et al. (2013); Hira (2010); Adams and Rau (2011); Fernandes et al. (2014), increasing financial literacy levels through financial education does not strongly contribute to individual's financial behavior.

The weak effect of financial literacy education on financial behavior can be attributed to the irrationality of human decisions and the difficulty of changing people's financial behavior. The deviation from rationality of human decision-making is introduced with the prospect theory of behavioral economics in the work by Tversky and Kahneman (1979) and the theory is linked to individual behavior through psychology and sociology.

Other than financial literacy, behavioral economists empirically find psychological factors such as impatience (Meier and Sprenger, 2010; Meier, 2011; Meier and Sprenger, 2013), confidence (Bearden et al., 2001), risk-taking (Jianakoplos and Bernasek, 1998) and planning for use of money (Lynch et al., 2010; Ameriks et al., 2003) have an impact on financial behavior. In addition, cultural factors such as religion (Guiso et al., 2003; Arrunada, 2010; Renneboog and Spaenjers, 2012), family ties (Alesina and Giuliano, 2014) and language (Chen, 2013) show a significant influence on economic outcomes. Fernandes et al. (2014) empirically find that, in comparison with psychological factors, financial literacy has a weak contribution to financial behavior.

Previous financial literacy and financial behavior studies do not focus on the impact of psychological and cultural factors on financial literacy. In addition, in financial literacy studies, no previous research explores the effect of cultural factors such as religiosity and family ties to financial behavior. In an attempt to bridge the gap in understanding human financial behavior, we include psychological and cultural traits as determinants of individual financial literacy and financial behavior, along with other determinants that are evident in the literature. In this study, we introduce cultural traits (family ties and religiosity) as determinants of financial literacy and financial behavior for the first time in a financial literacy study. We also introduce psychological traits (confidence and impatience) as determinants of financial literacy for the first time in financial literacy studies.

Our study is divided into three parts. Our first part proposes a theoretical model that links the cultural effect of family ties on the level of investment in financial literacy and financial behavior. We test this model using Survey of Health, Ageing and Retirement European data-set and find a significant negative effect of family ties on financial literacy and financial behavior. The Survey of Health, Ageing and Retirement data set is limited to European respondents which and therefore does not allow us to test our theoretical model in different regions. Moreover, this survey is limited to its own variables and questions which is not enough to explore our concept.

For that reason, we expand our study in two other parts using a primary data set where we collect data from three different regions which are Germanic (Germany and Holland), Arabic (Lebanon, Syria, Palestine, Tunis and Egypt) and Latin European (Spain and Portugal). We also introduce survey questions as proxies for other cultural factors such as religiosity. In addition, we introduce survey questions that serve as proxies for psychological factors such as confidence, impatience and risk-taking. The second part of our study is focused on finding the main determinants of financial literacy and the third part of our study is focused on finding the main determinants of financial behavior.

In this dissertation, we find the effects of numeracy, financial socialization by parents, cultural factors through family ties and religiosity and psychological traits such as impatience and confidence on financial literacy. Moreover, we find the effects of financial literacy, numeracy, financial socialization by parents, cultural factors (family ties and religiosity), psychological factors (confidence, impatience and risk) on financial behavior. Our proxies of financial behavior are savings behavior, budgeting, debt behavior, wealth accumulation, investment in complex financial instruments such as stocks, budgeting and retirement savings. Our proxies of financial literacy are the knowledge about numeracy, inflation, interest rates and diversification.

We present our empirical analysis using two data sets. The first data set is a secondary data set that we collect from the Survey of Health, Ageing and Retirement in Europe (SHARE) using WAVES 3, 5 and 6. We use the SHARE data to test a theoretical model that we present in chapter 2 which finds the effect of family ties on investment level in financial literacy and the effect of family ties and financial literacy on savings, wealth accumulation, investment in complex financial instruments and debt behavior. In this study, we apply regression analysis, instrumental variable (IV) regression and Generalized Method of Moments to analyze the SHARE data set. Our second data set is a primary data set that is collected using a survey across three geographic regions which are Arabic (Lebanon, Syria, Jordan and Palestine),

Latin European (Portugal and Spain) and Germanic (Germany and Holland). We use our primary data in our study in chapter 3 to find the effect of numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and a vector of demographics on financial literacy. We also use our primary data in chapter 4 to find the effect of financial literacy, numeracy, financial socialization by parents, family ties, religiosity, confidence, risk-taking, impatience and a vector of demographics on our financial behavior proxy measures, which are active saving, budgeting, punctual debt payment, retirement saving and stock market participation. To analyze our primary data set, we apply regression analysis, instrumental variable (IV) regressions, Generalized Method of Moments, Principal Component Analysis and Principal Component Regressions. In addition that that, we apply Artificial Intelligence techniques for the first time in financial literacy studies by using three machine learning algorithms which are Regression and Classification Trees, Random Forests and Quantile Regression Forests.

1.1 Statement of the Problem

The inability of financial education to improve individual wealth and decision-making (Cole et al., 2014) and the weak connection between financial literacy and financial behavior after controlling for omitted variable bias (Fernandes et al., 2014) can be a reason to question the presence of other factors that can better influence financial behavior.

For those reasons, more research on financial literacy is needed to find ways that make financial literacy better influence individual financial behavior; and to suggest new financial education programs and financial awareness campaigns for improving individual's financial wellness in good times and bad times.

1.2 Objective of the Study

The purpose of our study is to introduce cultural traits (religiosity and family ties) and psychological factors (confidence and impatience) as additional determinants of financial literacy. Moreover, we introduce cultural traits (family ties and religiosity) and psychological traits (confidence, impatience, risk-taking) as determinants of financial behavior. In our study, cultural traits such as religiosity, family ties and psychological factors such as confidence, risk-taking and impatience accompany social traits (numeracy, financial socialization by parents and demographics) as additional determinants of individual levels of financial literacy and financial behavior.

After controlling for the endogeneity of numeracy, we measure the influence of cultural traits, psychological traits and social traits on financial literacy (inflation, interest rates and diversification). Moreover, after controlling for the endogeneity of financial literacy, we measure the influence of cultural traits, psychological traits and social traits on financial behavior (savings, retirement, debt, budgeting, wealth accumulation and investing in complex financial instruments such as stocks). We attempt to find the determinants of financial literacy, and by how much financial literacy; in comparison with other psychological, social and cultural determinants, can influence financial behavior.

This study aims to shed light on the determinants of financial literacy and financial behavior in order to explore new ways to improve financial literacy education programs and policy interventions that can positively influence the financial behavior of individuals. Integrating cultural and psychological traits in financial education programs and public policies can be a solution to the inability of financial literacy investments to strongly improve financial behavior.

1.3 Research Questions

1. Do family ties and demographics influence the investment level in financial literacy in SHARE WAVE 3,5 and 6 data sets?
2. Do financial literacy, family ties and demographics influence our proxy measures of financial behavior in SHARE WAVE 3,5 and 6 data sets?
3. Do selected demographic characteristics, numeracy, financial socialization by parents, selected psychological factors and selected cultural factors influence financial literacy level of individuals in our primary data set?
4. Do financial literacy, selected demographic characteristics, numeracy, financial socialization by parents, selected psychological factors and selected cultural factors influence our proxy measures of financial behavior of individuals in our primary data set?
5. Is there an order of importance of numeracy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining the level of financial literacy in our primary data set?

6. Is there an order of importance of numeracy, financial literacy financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining our proxies of financial behavior in our primary data set?

1.4 Limitations

1. The study is limited to information acquired from literature review and survey instruments.
2. The study is limited to the sample collected from SHARE WAVE data sets and our primary data set collected in Arabic, Latin European and Germanic regions.
3. The study is limited to the use of English questionnaires in the Arabic (Lebanon, Egypt, Syria, Palestine, Tunis) and the Germanic region (Germany, Holland).
4. Findings from the study shall be carefully generalizable to any group other than the individuals in this study.

1.5 Significance of the Study

Poor financial literacy levels around the world Klapper et al. (2015) and the inability of financial education programs to strongly improve individual financial behavior Fernandes et al. (2014) reflect problems that cannot always improve the financial wellness of individuals.

This study examines a social, psychological and cultural framework in finding new potential determinants of financial literacy and financial behavior. We measure our determinants of financial literacy and financial behavior using intercultural samples across Europe and the Middle East that are chosen based on differences in religion, native language and family ties. An evidence of a cultural influence on financial literacy and financial behavior can suggest improvement opportunities that may assist policy makers to integrate cultural and psychological traits while constructing financial education programs and financial awareness campaigns.

1.6 Dissertation Contents

This dissertation is organized into five chapters. It reports research from the statement of the problem to recommendations for future study.

Chapter 1 introduces the problem and purpose of the study; it also establishes research questions, definitions, assumptions, limitations, and a statement of significance of the study.

Chapter 2 contains our first paper entitled "The effect of family ties on investment in financial literacy and individual financial behavior". Five areas are reviewed. First, an introduction to our first study is discussed. Next is a discussion of the review of literature on financial literacy, family ties and financial behavior. Then, we present our theoretical model which is an inter-temporal choice optimization model about the effect of family ties on investing in financial literacy and the effect of family ties and investing in financial literacy on savings behavior. Afterwards, we discuss our microeconomic data, the methodology used to test our theoretical model and data analysis and findings using the SHARE WAVE data sets. Finally, we present our conclusions and recommendations of our first study.

Chapter 3 presents our second paper entitled "Numeracy, psychological traits, cultural factors and financial socialization by parents: Are they determinants of financial literacy?". The first section introduces our study. The second section presents the review of literature on financial literacy, numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics. The third section presents the methodology used and sample selection in our second study. Section four presents the data analysis and findings. Section five concludes.

Chapter 4 contains our third paper entitled "Financial literacy, Numeracy, psychological traits, cultural factors and financial socialization by parents: Are they determinants of financial behavior?". The first section introduces our study. The second section presents the review of literature on financial literacy, numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience, demographics and our financial behavior proxy measures. The third section presents the methodology used and the sample selection in our second study. Section four presents the data analysis and findings. Section five concludes.

Chapter 5 presents our general conclusions and recommendations for further research.

1.7 General Literature Review

In this section, we present the current literature on determinants of financial literacy and financial behavior. We also present new factors that can influence the levels of financial literacy and financial behavior of individuals.

1.7.1 Conceptual Framework

Two concepts provide the framework for this study. We use:

(a) the theory of consumer socialization explained with financial socialization by parents, our psychological factors explained with impatience and confidence, and cultural factors explained with family ties and religiosity, as our framework for the financial literacy determinants of individuals;

(b) the theory of experimental economics explained with psychological (risk-taking, confidence, impatience) and cultural traits (family ties and religiosity), and the theory of consumer socialization explained with financial socialization by parents as our framework of the financial behavior determinants for individuals.

In the presence of a rich and vast literature on theories of education, few theories exist on education approaches for financial literacy. The concept of financial literacy has not presented prominently before the 2000's as few educational institutions around the world plan to include financial education as a main subject in their curriculum.

The lack of financial education programs may be due to the expectation that gaining financial literacy a matter of social learning. The first social theory that is applied in financial literacy studies is the theory of social learning that is posited by Bandura and Walters (1977) and it states that as social entities, people, learn by watching the behavior of others. Theories of social learning have been applied in financial literacy studies by Martin and Bush (2000); Hira (1997).

As an extension to social learning, a recently adopted theory in financial literacy studies is that of consumer socialization. The theory of consumer socialization states that children can learn the skills required to live through the high capacity of parents, school, media and peers (Ward, 1974; Moschis and Churchill, 1978).

Moschis (1985) introduces consumer socialization into financial literacy through the concept of financial socialization. Financial socialization can take different agents such as individual learning about budgeting and saving from parents, family, school, work experience and the media (Gudmunson and Danes, 2011). According to Moschis (1985), financial socialization is more important at the early age of an individual.

Based on these social theories, the individual learns from the people around them (Koonce et al., 2008; Grohmann et al., 2015) and studies empirically show that financial socialization through the family, peers, media and society contribute to individual financial literacy. In a critical paper that reviews 100 articles about financial socialization, Gudmunson and Danes (2011) propose a conceptual model that integrates financial socialization processes and outcomes into financial literacy. According to the authors, little attention is given to the importance of financial socialization in determining individual financial behavior. In their model, financial socialization by parents influences financial attitudes, knowledge and capabilities. In turn, financial attitudes, knowledge and capabilities influence financial behavior. Based on Gudmunson and Danes (2011)'s model, researchers conduct empirical studies on financial socialization and its influence on financial literacy and behavior. The results show a direct influence of financial socialization by parents, economics at school, academic ability and family background on financial literacy and an indirect effect of financial socialization by parents on financial behavior (Grohmann et al., 2015; Kim et al., 2015; Hira et al., 2013; Dohmen et al., 2010).

Specifically, Grohmann et al. (2015), endogenize financial literacy by presenting empirical evidence of financial socialization, academic ability, family background and business/economics education at the university influencing both financial literacy and financial behavior. The dual effect of financial socialization on financial literacy and financial behavior makes financial literacy an endogenous variable in explaining financial behavior. The problems with endogeneity are due to the case of omitted variables that can explain financial behavior. In the conceptual framework of social learning and consumer socialization, personal and family background, financial socialization by parents, and quality of education can influence the financial literacy level and financial behavior of individuals.

The experimental economic theory is a conceptual framework that is introduced in the study of financial behavior. This theory is based on psychology, sociology and behavior, and emphasizes that behavioral patterns affect financial behavior (Tversky and Kahneman, 1979).

Based on studies in psychology, Gill and Prowse (2016) show that learning is positively correlated to cognitive ability, agree-ability and emotional stability. In studies about the role of psychology in determining financial behavior, factors such as impatience (Meier and Sprenger, 2010; Meier, 2011; Meier and Sprenger, 2013), confidence (Arellano et al., 2014; Dohmen et al., 2010), trust (Dohmen et al., 2010), financial satisfaction (Kadoya and Khan, 2016), anxiety and orientation about the future (Kadoya and Khan, 2016) affect levels of financial knowledge.

Also, cultural traits empirically have an impact on economic outcomes through religion (Arrunada, 2010; Renneboog and Spaenjers, 2012; Guiso et al., 2003), family ties (Alesina and Giuliano, 2014) and language (Chen, 2013). Based on the experimental economic theory, factors that influence economic outcomes may vary between countries due to different cultures such as family ties, languages and religions. From that perspective, and in order to learn more about the determinants of financial behavior, an intercultural empirical study needs to be conducted in different countries with different religions and speak different languages. Those cultural traits are not introduced in financial literacy studies and are implemented in our study along with social and psychological traits.

In the previously applied theories in financial literacy, social learning and financial socialization through family advice, education, and peer influence play an important role in shaping an individual's financial literacy and financial behavior. Moreover, psychological factors and cognitive abilities can also play an important role in affecting the level of financial behavior of individuals.

Based on our selected sample, we track which factors influence financial literacy and financial behavior. To elaborate on our suggested model, a comprehensive scheme is presented in figure 1.1.

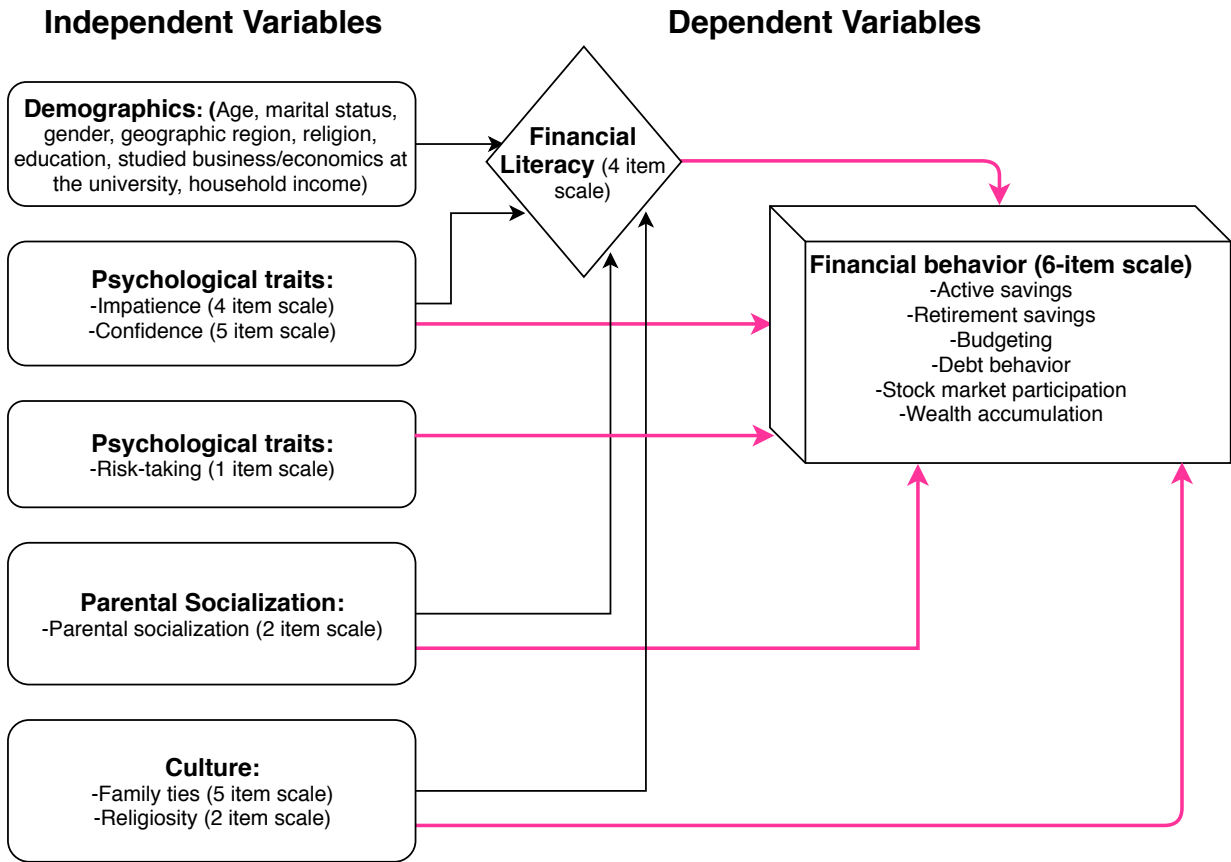


Figure 1.1: Our Conceptual Framework

In the next section, we present the current literature on financial literacy and financial behavior. We start by reviewing definitions of financial literacy, followed by the presentation of optimization models for investing in financial literacy. After that, we discuss the current literature on financial behavior. Finally, we discuss the literature related to our selected psychological and cultural traits.

1.7.2 Financial Literacy

In this section, we present popular literature related to the challenge to implement financial literacy in theory and practice.

1.7.2.1 Defining Financial Literacy

Financial literacy is defined in different ways. All definitions of financial literacy are either in a conceptual or operational forms. In 1997, Jump\$tart coalition surveys financial literacy for the first time and financial literacy is defined as the

ability to use skills and knowledge in order to effectively manage a person's financial resources for a lifetime financial security (Mandell, 2009). Afterwards, Financial literacy definitions take a more broad approach. According to Vitt et al. (2000), financial literacy is the ability to make financial choices, understand financial issues, make financial plans and adapt to economic changes through appropriate financial decisions. Moreover, according to the Presidents Advisory Council on Financial Literacy (PACFL, 2008), financial education is the process by which people improve their understanding of financial products, services and concepts, so they are empowered to make informed choices, avoid pitfalls, know where to go for help and take other actions to improve their present and long-term financial well-being. In addition, PACFL also defines financial literacy as the ability to use knowledge and skills to manage financial resources effectively for a lifetime of well-being. This definition is adopted from the Jump\$start coalition's definition.

Apart from the traditional ways to conceptually define financial literacy, Hung et al. (2009) find that financial knowledge, skills, behavior and mutual relationship should all contribute to the concept of financial literacy. In a paper that addresses the evolution of defining financial literacy, Remund (2010) conceptually defines financial literacy as a measure of the degree to which one understands key financial concepts and possesses the ability and confidence to manage personal finances through appropriate, short-term decision-making and sound, long-range financial planning, while mindful of life events and changing economic conditions.

Other definitions of financial literacy in academic literature include knowledge of financial products, knowledge of financial concepts and being engaged in financial planning (Hastings et al., 2013). Also, The US financial Literacy and Education Commission of 2007 and the Organization for Economic Co-operation and development (OECD, 2013) conclude their definition of financial literacy as the ability and awareness to use knowledge and skills to manage financial resources to achieve maximum financial well-being.

As researchers conceptually update the definition of financial literacy, few people focus on finding a practical definition that can specify how financial literacy is measured. Also, another problem in defining financial literacy is the endogeneity of financial literacy (Jappelli and Padula, 2013). The previous definitions of financial literacy are problematic in developing a measurement model for financial literacy due to the dilemma of multi-dimensionality, reverse causality and measurement error. Conceptual definitions of financial literacy are summarized in table 1.1.

Table 1.1: Resume of Conceptual Definitions of Financial Literacy

Author	Financial Literacy Definition
Vitt et al. (2000)	The ability to make financial choices, understand financial issues, make financial plans and adopt to economic changes through correct financial decisions
Hilgert et al. (2003)	Financial Knowledge
FINRA (2003)	“The understanding ordinary investors have of market principles, instruments, organizations and regulations” (p. 2).
Moore (2003)	“Individuals are considered financially literate if they are competent and can demonstrate they have used knowledge they have learned. Financial literacy cannot be measured directly so proxies must be used. Literacy is obtained through practical experience and active integration of knowledge. As people become more literate they become increasingly more financially sophisticated and it is conjectured that this may also mean that an individual may be more competent” (p. 29).
NCEE (2005)	“Familiarity with basic economic principles, knowledge about the U.S. economy, and understanding of some key economic terms” (p. 3).
Mandell (2007)	“The ability to evaluate the new and complex financial instruments and make informed judgments in both choice of instruments and extent of use that would be in their own best long-run interests” (pp. 163-164).
ANZ (2008),	“The ability to make informed judgments and to take effective decisions regarding the use and management of money” (p. 1).
Hastings et al. (2013)	Knowledge of financial products, knowledge of financial concepts and being engaged in financial planning
OECD (2013)	the ability and awareness to use knowledge and skills to manage financial resources to achieve maximum financial well-being

To simplify measuring financial literacy, Remund (2010) concludes that the four most common operational definitions of financial literacy are budgeting, saving, borrowing and investing. Operational definitions are used to find ways to measure financial literacy based on the suggested conceptual definitions.

Operational definitions that are used to measure financial literacy is divided between performance tests and self-reporting methods. Performance tests (Hilgert et al., 2003; FINRA, 2003; NCEE, 2005; Mandell, 2007; Van Rooij et al., 2011*b*) are knowledge based and are used as a reflection of the conceptual definitions. On the other hand, self-reporting or self-assessments (Lusardi and Tufano, 2015; Moore, 2003) measure the perceived individual knowledge and confidence in knowledge, in other words, how much individuals think they about financial matters.

While researchers are not convinced to use perceived financial knowledge to measure financial literacy, Agnew and Szykman (2005) find that the perceived and actual knowledge are modestly correlated, and caution should be taken if perceived knowledge is used as a proxy for actual knowledge (Hung et al., 2009).

One of the pioneers in financial literacy research, Lusardi and Mitchell (2007*a*) define financial literacy as the familiarity with the most basic economic concepts needed to make sensible savings and investment decisions. Lusardi and Mitchell (2014*b*) redefines financial literacy as the people's ability to process economic information and make informed decisions about financial planning, wealth accumulation, pensions and debt.

Fernandes et al. (2014) also narrows down the previously used dimensions and define financial literacy as the knowledge of basic concepts of personal finance with respect to borrowing/debt, and saving/investments that leads to better lifetime financial decision-making. This definition constructs financial literacy as a uni-dimensional factor that reflects objective knowledge with domains of knowledge in personal finance spanning savings/investments and borrowing debt. The operational definitions of financial literacy are presented in table 1.2.

With the presence of many conceptual and operational definitions of financial literacy, there is still no solid definition that can be used by researchers as a tool to develop effective financial education programs such that an increase in the level of individual financial literacy can attain a state of individual financial wellness. The problem with the previous definitions is their inability to contribute to designing a financial education model that can increase financial literacy and

Table 1.2: Resume of Operational Definitions of Financial Literacy

Author	Financial Literacy Definition
Remund (2010)	The four most common operational definitions of financial literacy are budgeting, saving, borrowing and investing.
Lusardi and Mitchell (2007a)	"Familiarity with "the most basic economic concepts needed to make sensible saving and investment decisions" (p. 36).
Lusardi and Tufano (2015)	"Focus on debt literacy, a component of financial literacy, defining it as "the ability to make simple decisions regarding debt contracts, in particular how one applies basic knowledge about interest compounding, measured in the context of everyday financial choices" (p. 1).
Lusardi (2008)	"Knowledge of basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basics of risk diversification" (p. 2).
Fernandes et al. (2014)	The knowledge of basic concepts of personal finance with respect to borrowing / debt, and saving/investments that leads to better lifetime financial decision-making
Lusardi and Mitchell (2014b)	Peoples' ability to process economic information and make informed decisions about financial planning, wealth accumulation, pensions, and debt.

the financial wellness of individuals.

Consequently, we need to further explore the determinants of financial literacy and use these determinants to build tools to strengthen financial literacy to improve financial behavior. To have a more specific operational definition of financial literacy that can be used in our study, we define financial literacy in 2 ways. Our first definition of financial literacy is **the knowledge of an individual about interest compounding, inflation and risk diversification with respect to savings/investments and borrowing/debt to improve financial decision making**. In addition, our second definition of financial literacy is **the knowledge of an individual about numeracy, interest compounding, inflation and risk diversification with respect to savings/investments and borrowing/debt to improve financial decision making**.

Applying these definitions makes financial literacy a unidimensional variable that is easy to measure. In addition, by using definitions of financial literacy, we employ two proxy measures of financial literacy. Using two proxy measures of financial literacy controls for the measurement error that is previously discussed in financial literacy studies. In the next section, we present the economic theories of financial literacy and how these theories can develop the factors affecting the financial literacy level of individuals.

1.7.2.2 Financial Literacy Investment in Optimization Models

Based on the conventional economic approach to consumption and saving decisions, a totally rational and well informed individual will have consumption below income in periods of high earnings, so that the individual can have enough savings to support periods of retirement and low income.

From this perspective, the individual will adjust her optimal saving and spending patterns in order to smooth marginal utility over time (Brumberg and Modigliani, 1954; Friedman, 1957). Such optimization process can be shaped by consumer preferences such as risk-taking and return, economic condition such as liquidity constraints, and the social safety net benefit such as the nature of social security system in a country (Lusardi and Mitchell, 2014*b*).

Few studies begin to explore decisions to acquire financial literacy and the links between financial knowledge and financial behavior. Delavande et al. (2008) is the first to present a two period model of portfolio allocation and consumer

saving through safe bonds and risky stocks, and thus, allowing for acquisition of human capital in terms of financial literacy. The model posits that individuals will optimally invest in financial knowledge in order to access higher gains on assets. The model has been inspired by Ben Porath's Cobb-Douglas production function for investment in human capital. The authors find that higher initial level of financial knowledge does not require a lot of investment in financial knowledge, which produces a higher indifference curve for investing in risky assets. Also, the results show that an increase in social security wealth will lower the incentive of investing in riskier assets. Moreover, individuals that are more patient want more benefits at retirement, and thus, will want to save more. A higher level of savings and investment in financial knowledge will increase the choice of investing in risky assets and more likely improve welfare.

Moreover, Jappelli and Padula (2011) present their financial literacy economic model, which considers a two-period model but also drafts a multi-period life cycle model with financial literacy being endogenously determined. The authors predict that financial literacy and wealth accumulation is strongly correlated over the life cycle with both rising until retirement and then falling afterwards. It has also been suggested that a generous social security system will lower incentives to save and accumulate wealth, and thus, will lower the reason to invest in financial knowledge.

A more recent model that is presented by Boisclair et al. (2017) and Lusardi et al. (2017) simulates and calibrates a dynamic life cycle where individuals undertake investment in financial knowledge along with selecting a combination between safe and risky capital market investments. The authors highlight the importance of financial literacy in closing the inequality gaps between individual wellness and welfare.

The rest of the simulation results have been as follows: Firstly, the endogenously determined optimal paths of financial literacy will be hump-shaped over the life cycle, that is, the levels of financial literacy will increase until retirement age and will start declining afterwards. Secondly, individuals will invest in financial literacy until the marginal time and effort costs are equal to the marginal benefits. Thirdly, financial literacy levels will differ across educational groups due to different income profiles over their life cycle. Boisclair et al. (2017) and Lusardi et al. (2017) predict that inequality in wealth and financial literacy will arise endogenously without the need to assume cross sectional differences in preferences or making other changes in the theoretical setup.

Moreover, there is an inequality in wealth across different countries with generous social security systems and

across education levels. This means that financial literacy will remain poor for specific subgroups who anticipate a high retirement income. In addition, financial education programs will not be very helpful for the least educated individuals because they will not find it important to invest in financial literacy.

Jappelli and Padula (2011); Boisclair et al. (2017) and Lusardi et al. (2017) have consistent findings which show that the least financially informed individuals are found in countries with generous social security systems. Also, they suggest that individuals value accumulating financial knowledge early in life as long as the costs do not exceed the benefits.

To summarize the findings of optimization models in financial literacy, investing in financial literacy can be acquired through personal efforts, forms of finance education programs and government awareness campaigns for financial advice. Optimization models of financial literacy endogenize financial literacy as a form of human capital investment. The models make way for empirical studies and policy insights to improve individual wellness through improving financial literacy. However, more optimization models are needed to include the effects of risk-taking, and psychological and cultural influences.

1.7.2.3 Measuring Financial Literacy

The Jump\$tart survey of American high school students is introduced in 2000 and is among the first to conduct annual surveys that measure financial literacy (Mandell, 2009). Later on, a set of three financial literacy questions are added by Lusardi and Mitchell (2011a) to the Health and Retirement Study in 2004. The “big three” questions cover three financial concepts which are compound interest, real rates of return and risk diversification. Two additional questions are added to “the big 3” by Hung et al. (2009) and thus using “the big 5”. The two additional questions are used to test knowledge about mortgage interest and bond prices.

Also, (Hung et al. (2009); Mandell (2009); Van Rooij et al. (2011b) and Deuflhard et al. (2014), use 26 common items to measure the construct of financial literacy on financial behavior.

A major criticism of financial literacy research is about how it is conducted with widely varying conceptualizations, dimensions and measures of the concept (Huston, 2010). For example, “the big 3” tool is not always comprehensive and may not apply to developing countries. Developing countries are characterized by inequality and high poverty rates, lack of consumer protection and less access of financial resources. The environment is varies considerably from that of

industrialized countries and thus defining financial literacy also differs (Xu and Zia, 2013). As an alternative, Carpena et al. (2011) uses numeracy, financial awareness and attitudes towards financial awareness to construct a three dimensional model for measuring financial literacy in India.

Most of the problems in the previous financial literacy measurements are related to the multi dimensionality and the inability to use the same measurement tool in different countries. The difficulty to use a unified measure of financial literacy can result in a measurement error of financial literacy. As an attempt to treat multidimensionality, Fernandes et al. (2014) use a 13 item psychometric financial literacy measure that uses the dimensionality of savings/investments and debt/borrowing. However, this measurement tool is not being tested for validity and reliability to be used in all countries. Moreover, in a global financial literacy study, Klapper et al. (2015) rely on a global financial literacy measure using questions assessing basic knowledge of four fundamental concepts in financial decision making: knowledge of interest rates, interest compounding, inflation and risk diversification.

To control for the measurement error of financial literacy, we use two proxy measures of financial literacy in our study. Our first measurement uses two questions about interest rates, one question about inflation and one question on portfolio diversification. Our second measure of financial literacy adds three numeracy questions about discount, weights and measurements, and values of products to the previous financial literacy questions.

1.7.2.4 Financial Literacy and Endogeneity

To control for the endogeneity of financial literacy in its effect on financial behavior, the need for cognition is used as an instrumental variable by Fernandes et al. (2014) and Estrada-Mejia et al. (2016). Meier (2011) finds that instrumenting for financial literacy is difficult due to the possibility of not controlling for omitted variables. According to Epstein et al. (1996), the need for cognition is a good instrument for financial literacy because this instrument is not plausibly caused by financial behaviors. The "need for cognition" is the individual tendency to engage in deliberately to ignore irrelevant information and evaluate ideas. The "need for cognition" is exogenous and thus, a suitable instrument for financial literacy (Fernandes et al., 2014).

In addition, Behrman, Mitchell, Soo and Bravo (2012) use three instrumental values to treat the causality and omitted variables in explaining financial literacy. The study aims at finding the effects of financial literacy and school-

ing on wealth accumulation. The instruments that are used are age-related factors such as government policies and macroeconomic conditions at the time of school, family background and personality traits (risk aversion, self esteem). After controlling for endogeneity using the candidate instruments, financial literacy shows a stronger impact on wealth accumulation.

The use of instrumental variables is essential in financial literacy studies due to the endogeneity problem of financial literacy. The endogeneity can be due to the reverse causality between financial literacy and financial behavior. In our study, we apply instrumental variables as an attempt to control for the endogeneity problem of financial literacy.

1.7.2.5 Financial Literacy and Financial Education

Governments and researchers often collaborate to improve individual financial behavior by attempting to increasing financial literacy levels and awareness through the design of financial education programs. In addition to financial education, researchers propose that policy changes and financial awareness campaigns be enacted by the government to facilitate the acquisition of financial literacy and improve financial behavior among the target population.

Supporters of financial education programs state that financial literacy is associated with the quality of financial decision making (Lusardi and Mitchell, 2014a, 2009; Van Rooij et al., 2011b; Campbell, 2006; Bernheim et al., 2001). However, the causal effect of financial education on financial outcomes has mixed results. In a study by Cole et al. (2014), requiring US high school students to take financial education courses had no effect on investment or credit outcomes.

In a meta-analysis study by Fernandes et al. (2014), most of the financial literacy interventions that propose a financial education program show a small effect size on financial behavior. The weak effect size of financial literacy and education can be due to wrong implementation of the courses or due to the inability of periodic financial education programs to change individual's financial behavior. Preferably, it is important to transfer financial education from classes into a course of life to help in improving financial behavior.

Opposed to the meta analysis of Fernandes et al. (2014), Kaiser and Menkhoff (2016) also conduct a meta-analysis of 115 papers that use interventions through financial education programs, and finds that financial education signifi-

cantly influences financial literacy. The results show that financial education is less effective in low to medium income countries. Moreover, financial education programs do not succeed in influencing individual borrowing behavior. In addition, mandatory financial education courses do not show to be less effective, and the authors propose applying financial education program at specific teachable moments. The results comply with the theoretical concepts of (Jappelli and Padula, 2013).

Financial education programs show mixed results when it comes to improving individual financial behavior. Before questioning the impact of financial education programs on financial behavior, we need to question the quality of financial education programs applied. The quality of the financial education programs can be affected by the qualification of the instructors, the amount of teaching hours given in the course and the distribution of the teaching hours over the term (few long sessions versus more short sessions). In addition, the quality of the financial education program is related to the target audience the program is approaching. The financial education program should target the individual characteristics of the audience as a part of the course objectives. The target of the people selected to take course has a lot to do with the effectiveness of the course. For example, individuals mostly learn at a younger age so implementing financial education in high school or applying policies that give incentives for parents to involve their children with financial matters are good suggestions to improve financial literacy among individuals. Also, the time gap between the end of the course and the time the individual starts using the acquired financial knowledge can affect the impact of the financial education program. People tend to forget the material they learn if they do not get a chance to practice what they learned.

To improve effectiveness of financial education on financial behavior, more experiments are needed to fill the gap between financial literacy and financial behavior. Finding the best ways to make interventions through financial education programs is attracting more research, and probably, with time, financial education programs may influence individual financial behavior. However, people will always tend to make financial mistakes regardless of their financial literacy levels. From this behavioral economic perspective, we will focus our research on finding other factors that influence financial literacy and financial behavior. In the next section, we present fiscal interventions that may influence the effect size of financial literacy on individual financial behavior.

1.7.2.6 Financial Literacy and Policy Changes

Another aspect that can influence the increase in financial literacy level of individuals is government and central bank policies in a state or country. The first policy to discuss is free financial advice. Free financial advice provided by financial institutions to its clients raises the financial literacy level of individuals and later boost the wealth accumulation of individuals (Boisclair et al., 2017). Another policy is the retirement benefit in a country. Jappelli and Padula (2013); Boisclair et al. (2017) and Lusardi et al. (2017) theoretically verify that a generous retirement benefit and social security system provided by the government can lower the need of individuals to invest in financial literacy. In that case, a country that provides a good retirement benefit for citizens may negatively affect the individual level of financial literacy, because individuals are less interested about acquiring financial knowledge in a country with a generous social security system, and in turn, will lower the incentives for to acquire financial literacy.

Moreover, the interest rate on saving accounts in a country may influence the need for the acquisition of financial knowledge. Lower levels of real interest rates earned on savings bank accounts will make the consumer that is seeking a retirement plan become eager to learn more about investing in other financial instruments that can give higher returns. As long as there are low discrepancies between riskless and risky investments, individuals will not find any incentive to invest in financial literacy in order to increase wealth. This policy is not covered previously in the financial literacy literature and such policy can be added in a new theoretical model for investing in financial literacy.

Hastings et al. (2013) and Meier and Sprenger (2010) propose that the governments and banks should help in providing default savings and enrollment in retirement plans when individuals enter the labor market. From the authors' point of view, individuals are not well informed about saving and retirement plans and the government should play a role in favor of its citizens. In addition to helping individuals to save for retirement using the right plan, without any hassle, banks will lower the level of default on credit cards and loans and thus incur a healthier economy and financial system.

Policy changes make a good mark on improving financial behavior, however, it is very important for countries to start implementing such policy changes in favor of individuals to improve their financial literacy and financial wellness, and consequently, to improve the nations' economic outcomes.

1.7.2.7 Financial Literacy and Demographics, Numeracy and Financial Socialization by Parents

Many studies show the financial literacy discrepancies among individuals. These studies show that financially literate people save more (Jacob et al., 2000), (Deuflhard et al., 2014), accumulate wealth (Behrman, Mitchell, Soo and Brava, 2012), choose better retirement plans (Lusardi and Mitchell, 2011c) and invest more in stocks (Van Rooij et al., 2011b). In these studies, researchers try to identify which demographic groups such as country, location, gender, ethnicity, occupation have better financial literacy. Using the results from these demographics better serves in selecting the right people to include in financial education programs.

Gender gaps in financial literacy are empirically evident. Financial literacy is lower for females (Lusardi and Mitchell, 2011c; Van Rooij et al., 2011b). Klapper et al. (2015) show that females are less financially literate in 135 out of 144 countries. The lower financial literacy level may be attributed to married women who rely on their husband's financial knowledge, yet, this explanation is negated after evidence of low financial literacy scores for single independent women. Moreover, gender gaps in financial literacy may also be attributed to the lower education, income and experience in financial affairs and gender inequalities (Mahdavi and Horton, 2014). Opposite to the findings of gender gap in financial literacy, Grohmann et al. (2016) show no gender gap for middle class individuals in Bangkok and the author may attribute this analogous result to the choice of country included in the sample.

Age also explains the financial literacy gaps between individuals. According to Lachance and Choquette-Bernier (2004), people tend to learn from their mistakes and eventually learn more over time. That is, the higher the age, the higher the expected level of financial literacy. However, Lusardi et al. (2017) show a hump-shaped level of financial literacy over age, which shows that people tend to lose part of their financial literacy after retirement due to the loss of cognitive skills or less need for financial literacy. In addition, Agarwal et al. (2009) find that initial level of financial literacy comes from experience and the decline of financial literacy at a later age is due to loss of cognitive abilities.

Education level of individual and the spouse also explain the gaps in financial literacy between individuals (Grohmann et al., 2015; Lusardi and Mitchell, 2011b). Moreover, behavioral economic theories that are in favor of cognitive abilities empirically show the positive impact of education on financial literacy (Gill and Prowse, 2016; Lusardi et al., 2010). Also, social learning theories relate the effect of spouse or parent education level on the individual's level of financial literacy.

Empirically, parents' education level influence their children's financial literacy (Mahdavi and Horton, 2014). Demographics explain some of the gaps in financial literacy levels among individuals and financial literacy and demographics can always be used in constructing financial education programs that aim at improving financial behavior.

It has a lot to do with personal traits when it comes to decision making at any financial occasion. In that case, relying on financial literacy as the only source to make the right financial decisions is questionable. We present a set of factors affecting financial behavior that are previously used in the literature.

In the current literature about financial literacy and its effect on financial behavior, many authors study the effect of numeracy on individual financial outcomes. Numeracy, which is defined as the ability to understand and use numerical information, is associated with an increase in personal wealth (Estrada-Mejia et al., 2016; Banks et al., 2011) and associated with house and stock market ownership (Almenberg and Widmark, 2011). In fact, a tight link between numeracy and financial literacy is evident in two of the three pioneering standard questions used to measure financial literacy (Lusardi and Mitchell, 2011c). Yet, Numeracy shows as a stronger factor than financial literacy in explaining financial wellness (Almenberg and Widmark, 2011). This empirical evidence creates a confusion in financial literacy studies and numeracy can serve as both, a determinant of financial literacy, and a proxy for literacy in determining financial behavior. To disentangle numeracy from financial literacy, Grohmann et al. (2015) only uses numeracy as determinant of literacy. However, numeracy is endogenized and education quality is associated as an input to numeracy. In our study, we integrate numeracy in our operational definition of financial literacy and use numeracy as a determinant of financial literacy and as a part of the financial literacy proxy measure. In addition, we use numeracy as a determinant of financial behavior.

In addition to numeracy, Grohmann et al. (2015) and Gudmunson and Danes (2011) find an evident effect of financial socialization by parents on financial literacy and financial behavior. In our study, we use financial socialization as both a determinant of financial literacy and a determinant of financial behavior.

1.7.3 Financial Behavior

Financial literacy receives a lot of attention from researchers and policy makers because of its potential to improve financial behavior. In this section we define financial behavior and present how the theories of social change can be

applied to financial behavior.

1.7.3.1 Defining Financial Behavior

Defining financial behavior is primarily influenced by the social behavior theory of (Ajzen and Fishbein, 1980). Xiao (2008) defines financial behavior as any human behavior that is relevant to money management. Common financial behaviors include cash, credit, and saving behaviors. A good financial behavior results in good financial wellness.

To appropriately define human behaviors or financial behaviors, the following issues are addressed: To choose behaviors or outcomes, to focus on a single act or a behavior category, to choose the right tool to measure the target behavior, and to choose between collecting data from self-reporting or observations.

1. Behavior vs. Outcomes

Finance education programs focus on increasing savings and decreasing debt of individuals. Changing the levels of individual savings and debt are outcomes of financial behavior. Behavior is not an outcome but only a contribution to the outcome (Ajzen and Fishbein, 1980). On the other hand, outcome is a result of behavior and other factors and behavior should lead to outcome.

2. Single Acts vs. Behavioral Categories

According to Ajzen and Fishbein (1980), behavior is observed by single acts or behavioral categories. A single act is a specific behavior that a person does, such as booking a flight ticket through credit.

3. Behavioral Elements

To appropriately define behavior, Ajzen and Fishbein (1980) posit that we should have four essential elements which are action (save, spend), target (save in bonds or stocks) context (retirement, travel) and time (once, every

month). While defining financial behavior in any research, details based on these dimensions should be included.

1.7.3.2 Measuring Financial Behavior

According to Ajzen and Fishbein (1980), individual behavior can be measured in different ways. Behavior can be measured in a binary form, whether or not to adopt a certain behavior (example: Do you borrow money?). In addition, behavior can be measured with multiple choices. For example, what is your payment method?

Another way to measure financial behavior is to quantify the behavior being performed. For example, how much do you save for your retirement every month? The last method to measure financial behavior is to measure the frequency of performing a behavior. For example, how often do you save money?

The ideal method to collect data on financial behavior is done through direct observations that can be done as a field study or lab experiment. However, this method is time consuming and costly (Ajzen and Fishbein, 1980). As a realistic alternative to direct observations, researchers mostly rely on self-reporting (questionnaires) which require less effort, time and cost.

Measuring financial behavior through self-reporting does not prove to be the most accurate, and in order to improve research in financial education, more studies should adopt direct observations to measure financial behavior (Xiao, 2008). Using surveys of self-reporting, the financial behavior measurements used in financial literacy papers are savings (Lusardi and Mitchell, 2009), retirement planning (Lusardi and Mitchell, 2011c, 2009), debt (Lusardi, 2011; Mandell, 2009), cash-flow management (Hogarth, 2002), investing (Bernheim et al., 2001), active Planning (Bernheim et al., 2001) and inertia (Mandell and Klein, 2007).

1.7.4 Psychological Traits

Tversky and Kahneman (1979) utilize the prospect theory of behavioral finance to counter the economists' assumption individuals make rational decisions based on their best interests. Unfortunately, people prove to be irrational when making personal decisions under risk. From that perspective, the prospect theory may also explain why increases in financial literacy does not always improve individual financial behavior. This argument suggests that along with financial

literacy, some psychological and cultural factors can better explain financial behavior (Hastings et al., 2013; Fernandes et al., 2014; Borghans and Golstyn, 2006) and economic outcomes (Renneboog and Spaenjers, 2012; Guiso et al., 2003; Chen, 2013).

In addition, psychological and cultural traits may serve to be useful in addressing the omitted variables problem that makes financial literacy incapable of fully explaining the financial behavior of individuals.

1.7.4.1 Impatience and the Discount Factor

In an experiment conducted by Meier and Sprenger (2013), impatience is identified as a psychological factor that influences financial behavior where patient people tend to make better financial decisions. Impatience is measured through the concept of discount factor. Discount factor identifies how every individual values the present against the future. People with high discount factors are the ones who value the present more and tend to be impatient.

1.7.4.2 Confidence

Another psychological trait discussed in the literature is confidence in finding financial information which is the level to which an individual is capable and assured to marketplace decisions and behavior. It has been linked to proactive use of information, processing and decision considerations (Bearden et al., 2001).

1.7.4.3 Risk-taking

A psychological trait that is used in the literature is the concept of individual risk-taking. Risk-taking is an important player in wealth accumulation and investing in retirement plans. According to Jianakoplos and Bernasek (1998), lower willingness to take risk by women predicts gender differences in wealth accumulation.

1.7.5 Cultural Traits

Researchers explore the effect of culture on economic outcomes Guiso et al. (2003), however, no previous studies exclusively study the impact of cultural traits on financial behavior. To explain the rationale behind the importance of

cultural traits in determining financial behavior, we discuss some economic aspects of religiosity and religion, and family ties.

1.7.5.1 Religiosity

Finance is an important subject in religions and this is clearly found in the Holy books of monotheistic religions. Weber (1904) is the first researcher to point out the impact of religiosity on economic outcomes. In his book, *The Protestant Ethic and Spirit of Capitalism*, he attributes the birth of capitalism to Protestantism, and specifically Calvinism.

From the above mentioned, Weber (1904) argues the importance of religiosity in influencing aggregate economic levels. Recent studies suggest that religiosity has a significant effect on individual's economic attitudes such as trust, planning and saving in the Netherlands (Renneboog and Spaenjers, 2012) and (Guiso et al., 2003). Renneboog and Spaenjers (2012) use religious affiliation as the way to measure religiosity. Religious affiliation is measured by how much an individual considers herself religious and how often she attends organized religious events such as church. In recent studies, Protestants have stronger social ethics (Arrunada, 2010) where as Catholics are more able to control their subjective well-being than protestants (Renneboog and Spaenjers, 2012).

The previous findings show that religion and religiosity among other factors can contribute to financial wellness. Religiosity and religion will be used as determinants of financial literacy and financial behavior in our study.

1.7.5.2 Family Ties

Along with religion, economists suggest that national savings differences can be explained by cultural differences. Other cultural aspects such as family ties may also have an influence on the financial wellness of individuals. Individuals rely on family recommendations on financial matters, and this can influence the financial well-being in different ways. In a family based society, the financial education of parents and siblings can play an important factor on individual's financial literacy and behavior.

Fukuyama (1995) argues that in parts of China and Italy, family ties are the stronger than any other kind of social bonds. In these countries, family is more important than the market and the government. In addition, according to Putnam et al. (1994) Asian and Latin American countries welfare and safety of individuals is provided by the family. This is especially true in countries with weak governments, rule of law and governance resulting in strong family ties and trust

in family members and weaker trust in government and labor markets.

Also, Esping-Andersen (1999) state that individuals obtain their welfare from three basic sources which are markets, government and family. With the presence of strong family ties, social risks are internalized by the family across generations. The individuals with strong family ties will attain their welfare through family values and rules. From that perspective, bad economic conditions are less painful on societies with strong family ties. Also, families with stronger ties tend to have a higher state of subjective well-being using health and happiness as well-being indicators.

According to Galasso and Profeta (2011), the strength of family ties has an effect on the type of pension system on any given country. Societies with nuclear families (weak family ties) facilitate the presence of a pension system which acts as a safety net as seen in Anglo-Saxon countries such as England.

In measuring family ties, Alesina and Giuliano (2014) construct a subjective variable on strength of family ties using three different questions from the World Values Survey. The three questions measure the parental duties of parents toward their children, the importance of the family and the love/respect children are expected to have for their parents. In cultures with strong family ties, individuals are less mobile and prefer more regulated markets; and the strong family ties provide a certain utility that further strengthens family ties.

Alesina and Giuliano (2014) study the effect of family ties on political participation, political action, measures of generalized morality, attitudes toward women in the society, labor market behavior and work attitudes. Based on the analysis of the cross-country waves from the World values Survey (80 countries between 1981 and 2010), strong family values are linked with lower political participation and action, lower trust levels to strangers, more interest in job security, less desire for innovation, and conservative attitudes toward working women. The authors use three subject questions for family ties. The results show that Scandinavian countries and many Eastern European countries have the weakest levels of family ties. In the middle range, France, Canada, the United States and the United Kingdom have neutral family ties and Italy, Spain and Portugal have strong family ties.

1.7.6 Gap in the Literature

It is still unclear whether financial literacy is an important factor for improving financial behavior, as well the definition of a proper measurement tool for financial literacy. The models used in finding the determinants of financial behavior tend to be fallible due to the problems of endogeneity that is apparent in omitted variable bias, reverse causality and measurement error. Research about psychological and cultural aspects of financial behavior in a multinational context is scarce, and individuals from different countries and cultures can behave differently due to difference in psychological and cultural traits.

Proceeding with the research gaps, institutions are still unable to propose a valid, consistent and effective financial education program that can positively change individual financial behavior. In addition, adopting self-reporting is a practical tool to measure financial behavior but it does not reflect the reality of a direct observation. More field research and lab experiments may provide better insights leading to solutions that can positively change individual financial behavior.

1.7.7 Summary of the Literature

Financial literacy by no means guarantees improved financial behavior. To know why, we need to better understand financial behavior. We also need to question the methodology of financial education programs, the importance of socialization, psychology and culture of individuals and the role of the government in promoting new policies meant to improve individual financial wellness.

We have presented the available literature on financial literacy and financial behavior. Dominated by women, the pioneers of our research field are Anna-Maria Lusardi, Olivia Mitchell, Justine Hastings, Angela Hung, Leora Klapper and Antonia Grohmann. Through further research, we expect that financial literacy will become a powerful tool that provides equal opportunities for females and males in order to attain higher level of financial wellness.

1.7.8 Contributions

In our study, we present a vast set of contributions that can improve future prospects of financial literacy studies in improving financial behavior.

Our first contribution is an update on the Jappelli and Padula (2011) inter-temporal choice model of investing in financial literacy. In our model, we introduce family ties as a determinant of the investment level in financial literacy of individuals and we also use family ties along with financial literacy as determinant of saving behavior. Our theory posits that the stronger the family ties, the less willing individuals are in investing in financial literacy. As such, individuals rely on family members to get a free financial advice instead of investing in financial education. Hence, individuals with strong family ties have a lower level of financial literacy compared with individuals with weak family ties. Moreover, individuals with strong family ties need to optimally save more than individuals with weak family ties as individuals with weak family use their financial knowledge to make better financial investments, resulting in higher return. Our empirical findings using SHARE WAVE European data sets are compliant with our theoretical model. Our second contribution is evident in using two proxy measures of financial literacy. Using two proxies of financial literacy can control for the measurement error that is evident in previous financial literacy studies.

The third contribution to financial literacy studies is the use of psychological traits and cultural factors as determinants of financial literacy and financial behavior. Using psychological and cultural factors controls for the omitted variable bias that is also evident in previous financial literacy studies. In addition, we control for reverse causality problem of numeracy and financial literacy by using instrumental variables. The instruments we choose are need for cognition, parental education, math skills at the age of 10 and language proficiency. Moreover, our financial literacy studies extend over three geographic regions, which are Latin Europe, Germanic Countries and Arabic countries. The reason for choosing these three geographic regions is to compare the cultural and psychological differences in their effect on financial literacy and financial behavior. Our sample is unique and suitable for a financial literacy studies that uses cultural factors such as family ties and religiosity in determining financial behavior.

As a fourth contribution, we apply Artificial Intelligence using three machine learning algorithms to rank the determinants of financial literacy and financial behavior by importance. This is the first financial literacy that uses machine learning algorithms. Finally, we propose new implementations of financial education programs around the world as an attempt to improve individual financial behavior.

CHAPTER 2

The effect of family ties on investment in financial literacy and individual financial behavior

Abstract

We present an inter-temporal consumption model that integrates the effect of family ties on an individual's investment in financial literacy. We posit that individuals with strong family ties tend to seek financial advice from their family network instead of improving their financial decision-making by investing in financial literacy. Thus, allows individuals with strong family ties substitute the costs of investing in financial literacy with consumption or saving. The result is a sub-optimal financial literacy level for individuals with strong family ties as opposed to ones with weaker family ties. Also, based on the assumption that a higher financial literacy level allows the individual to make better financial decisions and thus earn a higher return on savings, individuals with strong family ties will have lower return on savings which in turn requires them to optimally save more than ones with weaker family ties. The model drives our empirical approach to the analysis of the effect of family ties on financial literacy, and the joint effect of financial literacy and family ties on financial behavior. Using micro-economic panel data from SHARE WAVE 5, 6 and WAVE 3 SHARELIFE, we find strong support for the model's predictions. After controlling for endogeneity, a strong level of family ties shows a significant negative effect on financial literacy. On the other hand, strong family ties shows a significant negative effect on savings, investment in complex financial instruments, wealth and debt accumulation. In compliance with prior research, there is a positive effect of financial literacy on financial behavior. However, the effect weakens once we introduce family ties to our empirical model.

Index terms— Financial Literacy, Financial Behavior, Saving, Family Ties

2.1 Introduction

According to the standard model of inter-temporal choice, people maximize utility and choose their consumption and saving levels at any point in time on the basis of expected lifetime resources and preferences. In this model, individuals

are assumed to be rational and fully informed. Moreover, the model assumes that individuals are able to project future income and interest rates and to discount them in an appropriate way.

In reality, it is evident that a large part of the population knows little of financial concepts such as interest rates, inflation and diversification (Lusardi and Mitchell, 2011*b,c*). In addition, Van Rooij et al. (2011*b*) find that a higher level of financial literacy is associated with better planning for retirement and higher stock participation.

Moreover, numeracy, which is defined as the ability to understand and use numerical information, is associated with better financial decisions which in turn increases personal wealth (Estrada-Mejia et al., 2016; Banks et al., 2011). Additionally, Ameriks et al. (2003) and Lusardi and Mitchell (2007*b*) find evidence of a link between financial literacy and saving behavior.

However, endogeneity is seen as a central issue when studying financial literacy and behavior. In many studies, endogeneity of financial literacy is recognized without discussing the sources of endogeneity (Meier, 2011; Fernandes et al., 2014; Deuflhard et al., 2014). Previous studies encountering the endogeneity in financial literacy shows different findings. Lusardi and Mitchell (2011*b*) and Van Rooij et al. (2011*b*) show that OLS regressions underestimate the influence of financial literacy on financial behavior. On the other hand, Fernandes et al. (2014) after using the need for cognition as an instrumental variable find that OLS regressions tend to overestimate the influence of financial literacy on financial behavior. The authors posit that financial behavior has more influential determinants such as psychological traits. Moreover, Guiso et al. (2003) and Alesina and Giuliano (2014) show the strength of cultural factors such as family ties and religiosity on financial behavior.

With all the attention being channeled towards the importance of financial literacy on financial behavior, few studies give attention to the importance of family ties on financial behavior. Economists suggest that national savings differences can be explained by cultural differences. Strong patterns between family ties are linked to social and economic outcomes (Todd, 1985; Greif, 2006; Greif and Tabellini, 2010; Alesina and Giuliano, 2014).

Few studies explore decisions to acquire financial literacy and associate financial literacy with financial behavior. Jappelli and Padula (2011) provide an explicit framework to include financial literacy in an inter-temporal model. The

model posits that, to improve financial behavior, individuals invest in financial literacy to have better financial decisions. The result is explained in higher return on individual savings and investments. Yet, the model does not account for cultural traits such as family ties that can influence the likelihood of individual's choice of investment in financial literacy.

Yet, to date, family ties have not been taken into consideration in investment choice in financial literacy. In this paper, we posit that individuals with strong family ties can rely on financial advice from family members instead of paying for financial education courses and improving their financial literacy. However, individuals that rely on financial advice from family members will have lower levels of financial literacy as opposed to individuals with weak family ties. This makes individuals with strong family ties optimally save more after investing less in financial literacy. On the other hand, individuals with weak family ties optimally invest more in financial literacy and optimally save less because of the higher return they earn on savings.

In this paper, we emphasize the importance of family ties on individual investment choice in financial literacy and the effect of family ties on financial behavior. Building on the insights of Jappelli and Padula (2011), we propose a model of inter-temporal consumption that assumes that the individual level of family ties drives both the decision to invest in financial literacy and saving decisions. We assume that individuals with strong family ties invest less in financial literacy and have a different saving behavior as opposed to individuals with weak family ties. Our model implies that in a cross-section of households, a strong level of family ties is negatively correlated with the individual level of financial literacy and saving behavior.

We investigate the empirical implication of our theoretical model using micro-economic European cross-country data. In this data, we estimate two equations. The first equation finds the relationship between individual level of family ties and financial literacy. In the second, we track the influence of family ties and financial literacy on proxies of financial behavior (amount of savings, investing in complex financial instruments, wealth and debt accumulation). Our empirical approach recognizes the endogeneity of financial literacy and family ties in the regressions, and that the OLS estimates of the financial literacy and financial behavior regressions are biased. We use the initial level of verbal skills as an instrument for financial literacy.

The data sets are drawn from the Survey of Health, Aging, and retirement in Europe (SHARE) for individuals aged

more than 50 years old, and SHARELIFE, a retrospective survey of the same individuals. We define an indicator for financial literacy and family ties based on specific questions available in SHARE.

In our first regression estimate, we find that the initial level of financial literacy is strongly correlated with the current level of financial literacy. Moreover, the indicator of family ties has shown a non-linear effect on current level of financial literacy. We find a positive correlation at weak levels of family ties and a negative correlation at strong levels of family ties. That is, a strong level of family ties lowers the current level of financial literacy of an individual. When controlling for the endogeneity of family ties, initial financial literacy has had a weaker effect on current financial literacy whereas family ties have had a stronger significant effect on current financial literacy. This shows that the OLS underestimates the effect of family ties on current financial literacy.

In our second estimate, financial literacy shows a positive correlation with our four financial behavior proxies (savings, investment in complex financial instruments, wealth and debt accumulation). This means that a higher level of financial literacy is associated with higher savings, more investments in complex financial instruments, higher wealth and lower debt accumulation. Moreover, weak levels of family ties had a positive correlation with the 4 financial behavior proxies, while strong levels of family ties have shown a negative correlation with the same proxies. Strong family ties are associated with lower savings, less investment in complex financial instruments, less wealth and higher indebtedness.

Comparing OLS results with IV regressions using verbal skills as an instrument, we find that OLS estimates tend to underestimate the coefficients of financial literacy in the regression. Also, family ties have an influence on the four proxies of financial behavior in the IV regression models.

The rest of the paper is organized as follows. Section 2 presents the current relevant literature on financial literacy, family ties and financial behavior. Section 3 presents our inter-temporal model integrating the effect of financial literacy and family ties on saving behavior. Section 4 presents the econometric estimates selected, using micro-economic data. Section 5 concludes.

2.2 Financial Literacy and Financial Behavior

Based on the conventional economic approach to consumption and saving decisions, a rational and well-informed individual will have consumption below their income in periods of high earnings, so that the individual can have enough savings to support periods of retirement and low income. From this perspective, the individual is subject to arrange his optimal saving and spending patterns in order to achieve a smooth marginal utility over time (Brumberg and Modigliani, 1954; Friedman, 1957). Such optimization process can be shaped by consumer preferences such as risk taking and return, economic condition such as liquidity constraints, and the social safety net benefit such as the nature of social security system in a country (Lusardi and Mitchell, 2014b).

Few studies begin to explore decisions to acquire financial literacy and associate financial literacy with financial behavior. Delavande et al. (2008) is the first to present a two-period model of portfolio allocation and consumer saving through safe bonds and risky stocks, and thus, allowing for acquisition of human capital in terms of financial literacy. The model posits that individuals will optimally invest in financial knowledge in order to access higher gains on assets. The model is inspired by Ben Porath's Cobb-Douglas production function for investment in human capital. The authors find that investment in financial literacy is associated with investing in risky assets. In addition, they find that higher initial level of financial knowledge does not require a lot of investment in financial knowledge which produced a higher indifference curve for investing in risky assets. A higher level of savings and investment in financial knowledge will increase the choice of investing in risky assets and, more likely, improve welfare.

Also, Jappelli and Padula (2011) present a financial literacy economic model which considers a two-period model that drafts a multi-period life cycle model with financial literacy being endogenously determined. The authors predict that financial literacy and wealth accumulation will be strongly correlated over the life cycle with both rising until retirement and then falling afterwards.

A more recent model presented by Boisclair et al. (2017) and Lusardi et al. (2017) simulates and calibrates a dynamic life cycle where individuals undertake investment in financial knowledge along with selecting a combination between safe and risky capital market investments. The authors highlight the importance of financial literacy in closing the inequality gaps between individual wellness and welfare. The simulation results are as follows: firstly, the endogenously

determined optimal paths of financial literacy is hump-shaped over the life cycle, that is, the levels of financial literacy will increase until retirement age and will start declining afterwards. Secondly, investors invest in financial literacy until the marginal time and effort costs are equal to the marginal benefits. Thirdly, financial literacy levels differ across educational groups because of people's different income profiles over the life cycle.

The current literature on financial literacy and its effect on individual wealth have elicited research on the effect of numeracy on individual financial outcomes. Numeracy is shown as a stronger factor than financial literacy in explaining financial behavior (Almenberg and Widmark, 2011). This empirical evidence shows that numeracy has served to be both, a determinant of financial literacy, and a proxy for literacy in determining financial behavior.

Boisclair et al. (2017) and Lusardi et al. (2017) predict that inequality in wealth and financial literacy will arise endogenously without the need to assume cross-sectional differences in preferences or making other changes in the theoretical setup. Also, there is an inequality in wealth across different countries with generous social security systems and across individuals of different education groups. This means that financial literacy will remain poor for specific subgroups who anticipate a high retirement income. In addition, financial education programs will not be very helpful for the least educated individuals because such individuals will not find it important to invest in financial literacy. Theoretical models of financial literacy have endogenized financial literacy as a form of human capital investment. The models have made way for empirical studies to find the influence of financial literacy on financial behavior.

Van Rooij et al. (2011b) estimate the relation between financial literacy and wealth in a special module of the Dutch DNB Household Survey. In this module, financial literacy is measured using questions on the ability to perform simple calculations and to understand compound interest, inflation, money illusion and knowledge about investing in complex financial instruments like stock and mutual funds.

Lusardi and Mitchell (2011b) use the health and retirement study (HRS) and find that financial literacy is strongly correlated to the degree of portfolio diversification, even after controlling for other socioeconomic factors and proxies for risk aversion.

Because the true stock of financial literacy is not observed, empirical studies also face a measurement bias problem.

Behrman, Mitchell, Soo and Bravo (2012) use three instrumental values to treat the causality and omitted variables that explain financial literacy. The study aimed at finding the effects of financial literacy and schooling on wealth accumulation. The candidate instruments that are used are age-related factors such as government policies and macroeconomic conditions at the time of school, family background and personality traits (risk aversion, self-esteem). The authors run diagnostic tests to determine whether the chosen instruments are sufficiently strong (using F test for excluded instruments, Angrist-Pische multivariate F tests for excluded instruments and Kleibergen-Paap weak identification tests) and independent of second stage compound disturbance term (using the Hansen J statistic over-identification test). After controlling for endogeneity using the candidate instruments, financial literacy shows a stronger impact on wealth accumulation. After running the statistical tests, the instruments str sufficiently strong and independent of the error. This makes the chosen instruments valid to control for financial literacy.

Contrary to the previous study, Fernandes et al. (2014) use the need for cognition, an instrument suggested by Epstein et al. (1996), as an instrumental variable (IV) for financial literacy and find that financial literacy has a weaker influence on financial behavior in IV regressions.

Previous theoretical models and empirical works focus on how investing in financial literacy can have a good impact on financial behavior. Also, empirical studies attempt to treat the omitted variable bias and endogeneity problem of financial literacy. However, no prior theoretical models introduce the effect of cultural differences on the individual choice of investing in financial literacy and the effect of culture such as family ties on financial behavior.

2.3 Family Ties and Financial Behavior

Economists suggest that national savings differences can be explained by cultural differences. Cultural factors that are previously used in the literature are trust of non-family members, beliefs in individual effort, generalized morality, and a low obedience to the country systems (Guiso et al., 2003). Differences in family ties in different cultures and countries may also influence the financial wellness of individuals. For example, in countries where individuals rely on family recommendations on financial matters, the financial level of parents and siblings can play an important factor on individual's financial literacy and financial behavior.

The importance of family values and ties in explaining social capital, economic outcomes and political participation has gained the interest of researchers in the 1960's and 1970's. The idea that family ties may impede the economic growth of a nation goes back to the times of Weber (1904) who argues that strong family ties do not allow the individual entrepreneurship development where the latter is essential in forming capitalistic societies.

Fukuyama (1995) argues that in parts of China and Italy, family ties are stronger than any other kind of social bonds. In these countries, the family is more important than the market and the government. In addition, Putnam et al. (1994) refer to countries in Asia and Latin America where welfare and safety of individuals is provided by the family, which is attributed to weak governments and state structures. The people that come from regions with strong family ties tend to only trust the family members and have weak trust in governments and labor markets.

Strong patterns between family ties are linked to social and economic outcomes (Todd, 1985; Greif, 2006; Greif and Tabellini, 2010). Todd (1985) focuses on two family structures based on the authority of parents and the level of cooperation between subsequent generations. The first family structure is the nuclear family whose children leave the household at the time of marriage or before. The second family structure is the extended family which consists of three different generations living together and with equal cooperation under one authority (usually the eldest member in the family). The author argues that individuals in nuclear family structure are subject to independent economic opportunities and vice versa.

Beside the method of analyzing the type of family structure, Alesina and Giuliano (2014) construct a subjective variable on strength of family ties using three different questions from the World Values Survey. The three questions are constructed to measure the parental duties of parents toward their children, the importance of the family and the love/respect the children are expected to have for their parents.

The authors argue that in cultures with strong family ties, individuals are less mobile and prefer more regulated markets. Strong family ties provide a certain utility to the individual which increase with the strengthening of family ties in society.

Esping-Andersen (1999) states that individuals obtain their welfare from three basic sources which are markets, government and family. With the presence of strong family ties, social risks are internalized by the family across generations. The individuals with strong family ties attain their welfare through family values and rules. Galasso and Profeta (2011) also show the strength of family ties as an indicator to the type of pension system chosen by the country. In that case, societies with nuclear families (weak family ties) facilitate the presence of a pension system which acts as a steady safety net. This can be seen in Anglo-Saxon countries such as England.

Alesina and Giuliano (2014) study the effect family ties strength on political participation, political action, measures of generalized morality, attitudes toward women in the society, labor market behavior and work attitudes. Based on the analysis of the cross country waves from the World values Survey (80 countries between 1981 and 2010), strong family values are linked with lower political participation and action, lower trust levels to strangers, more interest about job security, less desire for innovation, and conservative attitudes toward working women. The authors use three subject questions for a family ties. The results show that Scandinavian countries and many Eastern European countries tend to have the weakest levels of family ties. In a middle range are France, Canada, the United States and the United Kingdom.

Little attention is given to the family as a relevant variable that explains economic outcomes. According to Banfield (1958) and Coleman and Coleman (1994), societies that are based on strong ties among family members, tend to promote good conduct only within small circles related to family and kin. On the other hand, societies that are based on weak ties among family members are willing to promote good conduct among circles that are outside family and kin. This intuition is confirmed experimentally by (Gambetta, 1988). After running a trust game played by a sample of British population, it was evident that people with strong family ties have a lower level of trust to strangers.

Guiso et al. (2003) develop a model that shows the influence of family ties on labor participation. Yet, no previous theoretical models introduce in the context of family ties as an influence on the individual investment in financial literacy and financial behavior.

In the next section we present our model of inter-temporal consumption model that integrates family ties as a determinant of individual choice for investing in financial literacy, which in turn affects the individual financial behavior.

2.4 The Theoretical Model

We integrate family ties in the standard model of inter-temporal choice previously presented by (Jappelli and Padula, 2013). The model highlights that accumulating financial literacy has both costs and benefits. Financial literacy allows consumers to make financial decisions that generate a higher return. We propose that the level of investment in financial literacy is influenced by the individual level of family ties. We assume that an individual with strong family ties would rather invest less in financial literacy because the individual prefers to rely on financial advice from family members.

The rationale behind this weighty assumption comes from a cross-country regression of financial literacy against family ties. We use the Global Financial Literacy Study of Klapper et al. (2015) to get the financial literacy score index of 56 countries. Also, we use the World Values Survey to get a proxy of family ties for the same selected countries. Our proxy for family ties uses a 5 scale Likert scale statement from WVS that asks the individual to identify how important the family is to them.

Regressing family ties (independent variable) against financial literacy (dependent variable) is shown in figure 2.1.

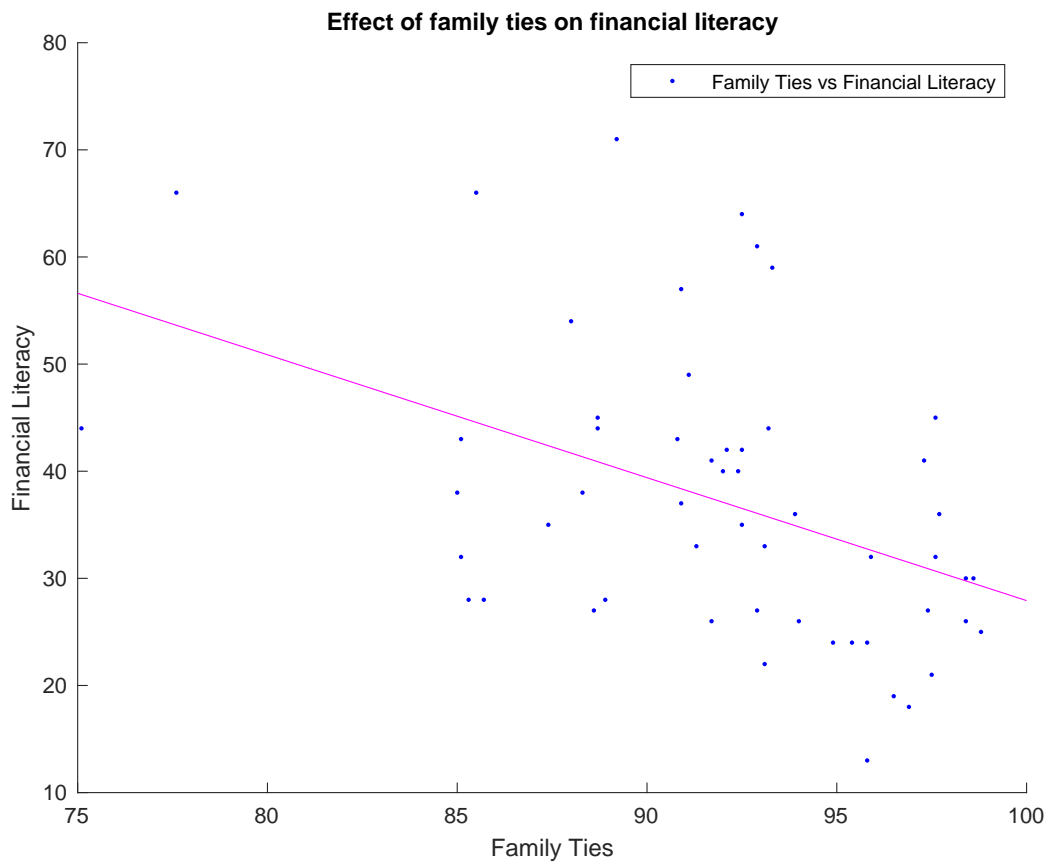


Figure 2.1: Plotting family ties against financial literacy

As we can see, family ties have a negative effect on financial literacy in this scatter plot. We use this regression to make an assumption in our model. Our assumption states that as the level of family ties increases, the individual's choice of investing in financial literacy decreases. Moreover, we assume no inter-generational transmission of family ties. In our model, we assume that the parents do not make any investment in family ties to pass to their children.

As in the model of Jappelli and Padula (2013), the life of consumer covers two periods and the consumer earns an income y in period 0 and live in retirement in period 1. At period 0, the consumer has no assets and owns an initial level of financial literacy Φ_0 that depreciate at a rate of δ . The return on saving is the interest factor α , where $\alpha \in (0, 1)$. Because investing in financial literacy provides better opportunities for higher return on investment decisions, the interest factor is a function of the level of financial literacy at period 1:

$$R(\Phi_1) = \Phi_1^\alpha$$

A consumer can increase financial literacy through buying financial literacy at a cost during period 0. However, the choice of buying financial literacy at period 0 is negatively influenced by the consumer level of family ties γ .

$$\Phi_1 = \Phi_0(1 - \delta) + \phi \quad (2.4.1)$$

Where ϕ is the investment level of financial literacy chosen by the consumer.

In the first period, consumers choose saving and financial literacy investment to maximize this utility function:

$$\ln c_0 + \beta \ln c_1$$

subject to the following constraints

$$y = c_0 + s + \gamma p \phi$$

and

$$c_1 = \Phi_1^\alpha s$$

Where c_0 is the consumption in period 0, c_1 is the consumption in period 1 and $\beta \in (0, 1)$ is the discount factor. y is the income received in period 0, γ is the level of family ties ($\gamma \in (0, 1)$), s is the saving level at period 1 and p is the cost of investing in financial literacy. We assume no inter-generational transmission of family ties in our model.

As we can see in the first budget constraint, a higher level of family ties γ leads to a higher cost of investing in financial literacy. This can be explained by making an assumption that the consumer with strong family ties does not need to invest more in financial literacy with the presence of family financial advice. From this perspective, a consumer

with strong family ties who invests in financial literacy will have an opportunity cost for not using the money to spend on financial literacy in other ways such as consumption or saving.

The first order conditions with respect to s and ϕ are:

$$s : \frac{c_1}{\beta c_0} = \Phi_1^\alpha \quad (2.4.2)$$

$$\phi : p = \frac{\alpha \beta c_0 s \Phi_1^{\alpha-1}}{\gamma c_1} \quad (2.4.3)$$

Using equations 2 and 3, we get the optimal level of saving as:

$$s^* = \frac{\gamma p \Phi_1}{\alpha} \quad (2.4.4)$$

This equilibrium level of saving shows a positive relation with the cost of financial literacy, the level of family ties and the level of financial literacy in period 1. From this equation, we can conclude that people with high level of family ties need to save more than individuals with weak family ties. Individuals with a high level of family ties would rather choose to save instead of investing in financial literacy. On the other hand, and based on the assumption that additional financial literacy provides better investment opportunities, individuals with low level of family ties would rather invest in financial literacy and receive higher returns on savings. From this perspective, individuals with weak family ties will save less and earn higher returns on their savings compared to individuals with strong family ties. Overall, individuals with strong family ties have different levels of optimal savings compared to individuals with weak family ties.

Using formulas 1, 2 and 3 with the budget constraints, the optimal amount of investment in financial literacy is:

$$\phi^* = \frac{1}{1 + \beta + \alpha \beta} \left[\frac{\alpha \beta y}{\gamma p} - (1 + \beta)(1 - \delta) \Phi_0 \right] \quad (2.4.5)$$

and the optimal level of saving irrespective of ϕ is:

$$s^* = \frac{\beta p}{1 + \beta + \alpha \beta} \left[\frac{y}{p} + \gamma \Phi_0 (1 - \delta) \right] \quad (2.4.6)$$

To have a graphical presentation of the adjusted model, we run some simulations of our optima based on two groups of observations, weak family ties ($\gamma \leq 0.5$) and strong ties ($\gamma > 0.6$).



Figure 2.2: Simulations for the inter-temporal model based on weak and strong family ties

In the first subplot 2.2, we can see the different behavior of investing in financial literacy between individuals with strong and weak ties. Individuals with weak family ties tend to invest much more in financial literacy and they tend to be more aggressive about investing in financial literacy as their family ties weaken. The second subplot in figure 2.2 shows the saving behavior of both groups. Simulations show that individuals with strong family ties have a higher saving optimal level compared to individuals with weak ties. Hence, our simple case of the inter-temporal model shows the

additional factor of family ties underlying decisions to invest in financial literacy.

In the next section, we present our empirical study to test the validity of our theoretical model.

2.5 Microeconomic Data

To make the model operational, we consider the linear estimates of current financial literacy on initial financial literacy (math proficiency at the age of 10), family ties (three proxies) and a vector of demographics that control for differences in preferences and economic resources. We also consider linear estimates of *logsaving*, *loginvestment* in complex financial instruments (bonds, stocks and mutual funds), *logwealth* and *logdebt* on current financial literacy, family ties and a vector of demographics.

2.5.1 Methodology

H_0 : There is no effect of initial level of financial literacy, family ties and demographics on the current level of financial literacy

H_1 : There is an effect of initial level of financial literacy, family ties and demographics on the current level of financial literacy

H_0 : There is no effect of the current level of financial literacy, family ties and demographics on our four proxies of financial behavior

H_1 : There is an effect of the current level of financial literacy, family ties and demographics on our four proxies of financial behavior

In our econometric models, we use four proxies of financial behavior, which are saving (Lusardi and Mitchell, 2011*b*), investment in complex financial instruments (Lusardi and Mitchell, 2014*b*), wealth (Jappelli and Padula, 2011) and indebtedness (Lusardi and Tufano, 2015). In our first econometric model, financial literacy is the dependent variable and math at 10, family ties (three proxies) and a vector of demographics are the independent variables. In our second econometric model, *logsaving* is the dependent variable. The independent variables are current financial literacy,

family ties (two proxies), and our control variables are presented with a vector of demographics.

Also, we use a third econometric model, which takes *loginvestment* as our dependent variable. The independent variables are the same as the second econometric model. The fourth econometric model uses *logwealth* as dependent variable and the fifth econometric model uses *logdebt* as a dependent variable. The independent variables are the same as the second and third econometric models.

We run the regressions on a panel data for years 2013 and 2015:

$$\Phi_{1,i,t} = \alpha + \beta_1 \Phi_{0,i,t} + \beta_2 \gamma_{i,t} + \beta_3 \gamma_{i,t}^2 + \beta_4 \Psi_{i,t} + \beta_5 X'_{i,t} + \varepsilon_{i,t}^{\Phi} \quad (2.5.1)$$

$$S_{i,t} = \alpha + \beta_1 \Phi_{1,i,t} + \beta_2 \gamma_{i,t} + \beta_3 \gamma_{i,t}^2 + \beta_4 \Psi_{i,t} + \beta_5 X'_{i,t} + \varepsilon_{i,t}^S \quad (2.5.2)$$

$$I_{i,t} = \alpha + \beta_1 \Phi_{1,i,t} + \beta_2 \gamma_{i,t} + \beta_3 \gamma_{i,t}^2 + \beta_4 \Psi_{i,t} + \beta_5 X'_{i,t} + \varepsilon_{i,t}^I \quad (2.5.3)$$

$$W_{i,t} = \alpha + \beta_1 \Phi_{1,i,t} + \beta_2 \gamma_{i,t} + \beta_3 \gamma_{i,t}^2 + \beta_4 \Psi_{i,t} + \beta_5 X'_{i,t} + \varepsilon_{i,t}^W \quad (2.5.4)$$

$$D_{i,t} = \alpha + \beta_1 \Phi_{1,i,t} + \beta_2 \gamma_{i,t} + \beta_3 \gamma_{i,t}^2 + \beta_4 \Psi_{i,t} + \beta_5 X'_{i,t} + \varepsilon_{i,t}^D \quad (2.5.5)$$

Where Φ_1 is the current level of financial literacy, Φ_0 is the initial level of financial literacy, *gamma* is our first proxy of family ties which is the frequency of contacting the oldest child, Ψ is our second proxy of family ties which is the frequency of giving help to family members and X' is a vector of demographics. We use four proxies of financial behavior in equations 2.5.2, 2.5.3, 2.5.4 and 2.5.5. S is for the amount of savings, I is for the amount of investing in complex financial instruments, W is for the amount of wealth accumulation and D is the amount of debt accumulation.

To estimate the model, we use micro-economic panel data set with information on savings and investment in complex financial instruments (bonds, stocks, retirement plans and mutual funds), wealth and debt accumulation, measures

of initial financial literacy, current levels of financial literacy and demographic variables. The data are drawn from WAVE 5, 6 and 3 of SHARE, a sample that represents a sample of the population aged 50 and above in several highly populated European countries. The survey covers aspects of well-being of elderly populations, ranging from socio-economic to physical and mental conditions. WAVE 5 refers to the year 2013 and WAVE 6 refers to the year 2015. WAVE 3 SHARE-LIFE data refers to the year 2009 and the data represents a retrospective survey of the individuals surveyed in SHARE WAVE 5 and 6. The SHARE WAVE 5 and 6 cover 14 countries (Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Luxembourg, Israel, Slovenia, Spain, Sweden and Switzerland).

In WAVE 5 and 6, respondents are presented with four financial and numeracy questions, on the basis of which we construct a proxy for the level of current financial literacy of individuals. The first question is to understand whether individuals know how to compute a percentage. The second and third questions ask individuals to compute the price of a good if there is a 50% discount, and the price of a second hand car that sells at two-thirds of its cost when new. The fourth question is about interest rate compounding in a savings account, and is commonly regarded as a very good proxy for financial literacy, see (Lusardi, 2008, 2011). The answers to these questions are combined into a summary indicator. The latter is our measure of the current stock of financial literacy Φ_1 . Details of the actual questions, and the construction of this indicator are given in Appendix A.1.

Φ_0 is the initial level of financial literacy before entering the labor market. WAVE 3 of SHARELIFE provide a good proxy for the initial level of financial literacy. Survey respondents report their subjective mathematical ability at the age of 10, in response to the following questions: "How did you perform in Maths compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?"

γ is the level of family ties and it is considered as a variable to include in our study. A proxy for family ties have been chosen from WAVES 5 and 6 data using a question from the survey that asks "how frequent do you visit your eldest child?" Do you visit daily, twice a week, several times a week, about once a week, about every two weeks, about once a month, less than once a month, or never? Ψ is another proxy for family ties which is the number of times the individual has given care to family members. The answers vary between 0,1 and 2 times. γ and Ψ are our variable contributions to the econometric model. These variables are not used previously in financial literacy studies and are implemented as independent variables in our empirical study.

The proxy for current financial literacy and initial financial literacy range from 1 to 5. The first Family ties proxy ranges from 1 to 7 and the second family ties proxy ranges from 0 to 2. In our first econometric model, current level of financial literacy Φ_1 is the dependent variable as suggested by (Jappelli and Padula, 2011). The independent variable is a quadratic fit of family ties and our control variables present a vector of demographics (age, years of education, log income, marital status and gender).

To analyze this data, we apply Ordinary Least Squares (OLS) regressions with country fixed effects, Instrumental Variable regression and Generalized Method of Momentum (GMM). The reason for using OLS with country fixed effects is based on the assumption which states that unobservables that might simultaneously affect the right hand side or the left hand side of the regression are time-invariant. Accepting this assumption gives us a powerful tool for removing omitted variable bias. This tool is known as fixed effects regression and it exploits within-group variation over time. As discussed in the literature review, measuring the effect of financial literacy on financial behavior is problematic due to the problem of omitted variable bias. By including fixed effects, we are controlling for the average differences across countries in any observable or unobservable predictors, such as financial literacy and family ties. The fixed effect coefficients soak up all the across-group action. What is left over is the within-group action, which is what we want. You can greatly reduce the threat of omitted variable bias. Because fixed effects models rely on within-group action, we need repeated observations for each group, and a reasonable amount of variation of our key independent variables within each group. One potentially significant limitation of fixed effects models is that we cannot assess the effect of variables that have little within-group variation (Verbeek, 2008). In our data set, we have 29,990 observations which are sufficient for our fixed effects. In previous financial literacy studies, country fixed effects are applied (Jappelli and Padula, 2013; Behrman, Mitchell, Soo and Bravo, 2012; Van Rooij et al., 2011b).

We also apply Instrumental Variables (IV) regression which is widely used when the correlation between the error term and the independent variables is suspected. This is attributed to endogeneity or measurement bias and omitted variable bias. As discussed in the literature review, a main challenge in finding the true effect of financial literacy on financial behavior is the endogeneity of financial literacy.

$$y_i = x_i' + u_i \text{ for } i = \{1, \dots, N\}$$

The idea is that we can replace the actual realized values of x_i , which are correlated with u_i by predicted values of x_i , that are related to the actual x_i but uncorrelated with u_i . Then, we can obtain a consistent estimator of β . Predicted values are formed by projecting x_i on a set of instrumental variables or instruments, which are required to have two important properties. The first property is that the instruments should be related to the explanatory variable(s) x_i , in other words, informative. The second property is that the instruments should be uncorrelated with the error u_i , in other words, valid. That is, the first property ensures that the predicted values are related to x_i and the second property ensures that the predicted values are uncorrelated with u_i . The general method in practice is finding instrumental variables that have both these properties. But assuming that we have good instruments available, we consider the method of Two Stage Least Squares (2SLS) (Verbeek, 2008).

To explain the Two Stage Least Squares, we consider a model with a single endogenous independent variable x_i and a single instrument z_i , where both assumes to have mean zero for simplicity.

$$y_i = x_i\beta + u_i \text{ for } i = \{1, \dots, N\}, \text{ where } E(u_i) = 0, E(x_i u_i) \neq 0$$

$$u = X\beta + u, \text{ where all vectors are } N \times 1$$

For the first stage regression:

$$x_i = z_i\pi + r_i \text{ for } i = \{1, \dots, N\} \quad X = Z\pi + r, \text{ where all vectors are } N \times 1$$

We require $E(z_i u_i) = 0$ so that the instrumental variable z_i is valid.

We also require $\pi \neq 0$ such that $E(z_i x_i) \neq 0$, so that the instrumental variable z_i is informative.

We estimate the first stage regression coefficient π using OLS

$$\hat{\pi} = (Z'Z)^{-1}Z'X$$

and form the predicted values of $X = (x_1, \dots, x_N)'$

$$\hat{X} = Z\hat{\pi} = Z(Z'Z)^{-1}Z'X$$

Second stage regression

$$y_i = \hat{x}_i\beta + (u_i + (x_i - \hat{x}_i)\beta) \text{ for } i = \{1, \dots, N\}$$

$$Y = \hat{X}\beta + (u + (X - \hat{X})\beta), \text{ where all vectors are } N \times 1$$

The second component of the error term is a source of finite sample bias but not inconsistency and it also has to be noted when constructing standard errors. We estimate the second stage regression coefficient β using OLS

$$\hat{\beta}_{2SLS} = (\hat{X}'\hat{X})^{-1}\hat{X}'y$$

using the symmetry of $(Z'Z)^{-1}$ subject to $[(Z'Z)^{-1}]' = (Z'Z)^{-1}$

The $\hat{\beta}_{2SLS} = \hat{\beta}_{OLS}$ in the special case where $z_i = x_i$ and hence $\hat{x}_i = x_i$

This is very intuitive, that is, if we project x_i on itself, we obtain perfect predictions and the second stage of the 2SLS coincides with the OLS regression. The previous expressions for the 2SLS estimator remain valid when we have several independent variables and several instrumental variables. 2SLS regressions are commonly used in financial literacy studies (Jappelli and Padula, 2013; Lusardi and Mitchell, 2011c; Behrman, Mitchell, Soo and Bravo, 2012). In our study, we will apply Instrumental Variables, where we select math skills at the age of 10 and language proficiency as instruments based on (Jappelli and Padula, 2013; Fernandes et al., 2014).

In addition to 2SLS Instrumental Variables regression, we apply Generalized Method of Momentum (GMM). GMM is

also an Instrumental Variables regression, however, it provides a more general rationale for the two stage least squares (2SLS), when the number of instruments exceeds the number of dependent variables, and the choice of weight matrix matters for asymptotic efficiency.

We write the model as

$$y_i = x_i' \beta + u_i(\beta) \text{ for } i = \{1, \dots, N\}, \text{ where } E(u_i) = 0, E(z_i u_i) = 0$$

GMM estimators choose β to minimize the weighted quadratic distance

$$u' Z W_N Z' u$$

for some weight matrix W_N

Intuitively, GMM chooses the value of β that allows $u_i(\beta) = y_i - x_i' \beta$ to satisfy the population moment conditions $E(z_i u_i) = 0$ as closely as possible in a weighted quadratic distance sense in the sample. Different choices of the weight matrix W_N produce different GMM estimators, based on the moment conditions $E(z_i u_i) = 0$

$$\text{Setting } W_N = (Z' Z)^{-1}$$

and minimizing $u' Z (Z' Z)^{-1} Z' u$

yields the 2SLS estimator $\hat{\beta}_{2SLS}$

$\hat{\beta}_{2SLS}$ is thus a GMM estimator.

GMM is suitable in case there is a heteroskedasticity in the Instrumental Variables regression. We run a Breusch-Pagan test and find that our sample is heteroskedastic. For that reason, we also apply GMM estimate to control for the heteroskedasticity problem in our sample.

Ordinary Least Squares (OLS) with country fixed effects, Instrumental Variables regression and Generalized Method of Moments (GMM) are applied in chapters 2, 3 and 4.

2.5.2 Data Analysis

In this section, we describe and analyze the data used from SHARE WAVE 3,5 and 6 using the years 2013 and 2015. A detailed explanation on the construction of our dependent and independent variables is presented in section A.1, A.2 and A.3. In 2.3, we find that the highest levels of financial literacy are present in Scandinavian countries. Moreover, the highest levels of family ties are evident in Latin European countries such as Spain and Italy. Descriptive statistics are available in tables 2.1 and 2.2

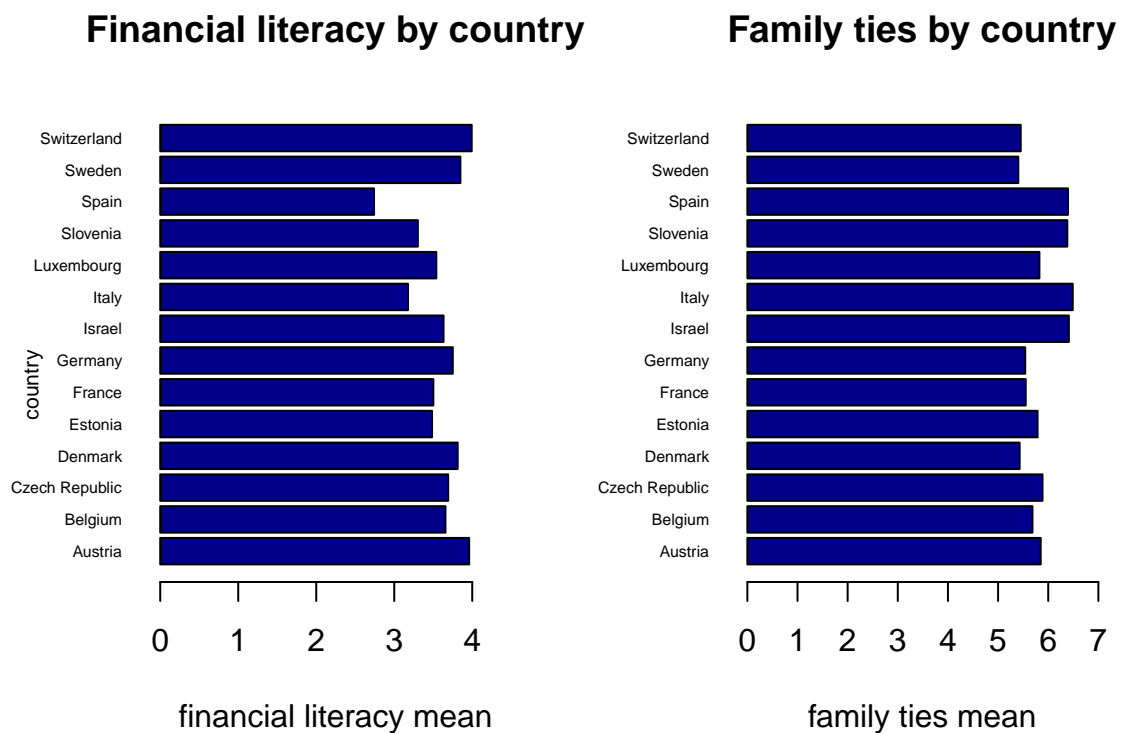


Figure 2.3: Average financial literacy and family ties by country

Table 2.1: Descriptive statistics of the selected discrete and continuous variables in SHARE WAVE 3,5 and 6.

Statistic	N	Mean	St. Dev.	Min	Max
age	29,990	66.579	9.297	26	103
education	29,990	11.435	4.318	0.000	25.000
current financial literacy	29,990	3.575	1.013	1	5
family contact	29,990	1.653	0.781	1.000	7.000
gave care to family	29,990	0.085	0.282	0	2
received care from family	5,064	0.266	0.482	0	3
log saving	29,990	7.471	3.296	0.000	13.393
log invest	29,990	2.702	4.593	0.000	15.161
log income	29,990	10.068	1.361	0.000	13.943
log wealth	29,990	11.702	2.117	0.000	16.608
contact with 1st child	29,990	5.828	1.346	1	7
math at 10	29,990	3.340	0.881	1	5
language at 10	29,990	3.356	0.845	1	5
log_debt	29,990	1.413	3.296	0.000	13.072

Table 2.2: Descriptive statistics of factor variables.

Variable	Levels	n	%	\sum %
country	Austria	1820	6.1	6.1
	Belgium	2798	9.3	15.4
	Czech Republic	2930	9.8	25.2
	Denmark	2410	8.0	33.2
	Estonia	2650	8.8	42.0
	France	1862	6.2	48.3
	Germany	2896	9.7	57.9
	Israel	887	3.0	60.9
	Italy	2185	7.3	68.2
	Luxembourg	758	2.5	70.7
	Slovenia	1849	6.2	76.9
	Spain	2516	8.4	85.3
	Sweden	2664	8.9	94.1
	Switzerland	1765	5.9	100.0
all		29990	100.0	
gender	Female	17001	56.7	56.7

	Male	12989	43.3	100.0
	all	29990	100.0	
marital status	Divorced	1822	6.1	6.1
	Married, living with spouse	24250	80.9	86.9
	Married, not living with spouse	305	1.0	88.0
	Never married	526	1.8	89.7
	Registered partnership	419	1.4	91.1
	Widowed	2668	8.9	100.0
	all	29990	100.0	

Note: The table reports sample statistics for selected variables in SHARE WAVE 5 and 6.

The results for our first econometric model in equation 2.5.1 are present in table 2.3. Country fixed effects are applied to all our econometric models. To ensure robustness, we sub-sample the regressions by removing countries with a lot of observations like Spain and Italy. The results are consistent with the full sample. In the OLS regressions, we can notice that the influence of current financial literacy remains the same as we introduce family ties. An increase in one standard deviation of math skills at age of 10 result in an increase of 0.23 standard deviation on financial literacy.

Our first proxy for family ties which is the frequency of contact with first child shows a quadratic influence on current financial literacy. Family ties has a positive significant influence on current financial literacy for low levels of family ties (below 4), and family ties have a significant negative influence on current financial literacy at weak levels of family ties (above 4). That is, at a weak level of family ties, an increase in one standard deviation results in a significant increase of 0.12 standard deviation in financial literacy. And, at a strong level of family ties, an increase of 1 standard deviation results in a significant decrease of 0.01 standard deviation in financial literacy.

In addition, our second proxy for family ties which is the frequency of giving care to family members shows a significant negative effect on the current level of financial literacy. An increase in 1 unit of giving family care has a significant decrease of 0.07 standard deviations on financial literacy. This is an important result that shows how initial financial literacy is not the only determinant of current financial literacy. It is noticeable that family ties have a significant influence

on the current level of financial literacy. The influence of family ties is positive at weak levels of family ties and negative at strong level of family ties.

To control for the endogeneity of the initial level of financial literacy, we use verbal skills at the age of 10 for individuals from the WAVE3 survey data as an instrument. This instrument is used by Guiso et al. (2003). From the results of the instrument diagnostics, we find that language skills at the age of 10 is a valid instrument for family ties. We also introduce other instruments such as the frequency of receiving care from family members and the level of family socialization in a social network.

The IV regression and Generalized model of momentum also show that higher math levels at 10 have a stronger positive effect on financial literacy. Also, weak contact with first child has a positive influence on current financial literacy, as opposed to strong contact with first child whom significantly influence current financial literacy negatively. Also, giving more family care results in a negative effect on financial literacy. The results remain significant and diagnostics are presented in table 2.3.

Table 2.3: Regression results for financial literacy as dependent variable

	GMM	IV	OLS	OLS
math at 10	0.43*** (0.06)	0.31*** (0.02)	0.23*** (0.01)	0.23*** (0.01)
contact with 1st child	0.11* (0.06)	0.11*** (0.02)	0.12*** (0.02)	
contact with 1st child squared	-0.01** (0.01)	-0.01*** (0.00)	-0.01*** (0.00)	
gave care to family	-0.09 (0.06)	-0.07*** (0.02)	-0.07*** (0.02)	
education	0.04*** (0.01)	0.05*** (0.00)	0.05*** (0.00)	0.05*** (0.00)
gender: male	0.35*** (0.04)	0.30*** (0.01)	0.31*** (0.01)	0.31*** (0.01)
log income	0.09*** (0.01)	0.04*** (0.00)	0.05*** (0.00)	0.05*** (0.00)
age	-0.02*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
married, living with spouse	0.10 (0.09)	0.09*** (0.02)	0.10*** (0.02)	0.10*** (0.02)
married, not living with spouse	0.10 (0.18)	0.07 (0.05)	0.08 (0.05)	0.08 (0.05)
never married	0.23 (0.19)	-0.03 (0.04)	-0.02 (0.04)	-0.03 (0.04)
registered partnership	0.03 (0.22)	0.06 (0.05)	0.06 (0.05)	0.06 (0.05)
widowed	0.03 (0.10)	-0.04 (0.03)	-0.04 (0.03)	-0.04 (0.03)
Criterion function	51.32			
R ²		0.18	0.19	0.18
Num. obs.	5064	29990	29990	29990
Diagnostics for IV regression				
	df1	df2	statistic	p-value
Weak instruments (math at 10)	2	29962	2081.775	2e-16***
Wu-Hausman	1	29962	26.366	2.84e-07***
Sargan	1	NA	0.998	0.318
Diagnostics for GMM				
J-Test: degrees of freedom is 1				
Test E(g)=0:			J-test 2.59873	p-value 0.10695
Instrumented: math at 10 Instruments: language proficiency at 10, received care from family members, family contact in a social network				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions. The panel data includes WAVE 5(2013) and WAVE 6(2015)

We get similar results after removing Spain and Italy one at a time

An error of 0.00 is a rounded value

Standard errors are in parentheses

Table 2.4: Regression results for log saving as dependent variable

	GMM	IV	OLS	OLS
financial literacy	1.71*** (0.41)	1.10*** (0.20)	0.30*** (0.02)	0.31*** (0.02)
contact with 1st child	0.41** (0.20)	0.26 (0.16)	0.58*** (0.06)	
contact with 1st child squared	-0.04** (0.02)	-0.02 (0.02)	-0.06*** (0.01)	
gave care to family	-0.11 (0.18)	-0.02 (0.12)	-0.18*** (0.06)	
education	-0.04 (0.03)	0.03* (0.02)	0.06*** (0.00)	0.06*** (0.00)
gender: male	-0.59*** (0.20)	-0.34*** (0.12)	-0.02 (0.03)	-0.02 (0.03)
log income	0.83*** (0.07)	0.42*** (0.05)	0.47*** (0.01)	0.47*** (0.01)
age	0.06*** (0.01)	0.05*** (0.01)	0.02*** (0.00)	0.02*** (0.00)
married, living with spouse	0.19 (0.28)	0.26 (0.20)	0.54*** (0.07)	0.58*** (0.07)
married, not living with spouse	0.36 (0.57)	0.09 (0.47)	0.19 (0.17)	0.19 (0.17)
never married	0.03 (0.51)	-0.20 (0.39)	-0.09 (0.14)	-0.09 (0.14)
registered partnership	-0.60 (0.60)	-1.05** (0.49)	0.22 (0.15)	0.21 (0.15)
widowed	-0.53* (0.32)	-0.43* (0.23)	-0.08 (0.09)	-0.07 (0.09)
Criterion function	74.48			
R ²		0.05	0.08	0.08
Num. obs.	5064	5064	29990	29990
Diagnostics for IV regression				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	2	5036	139.792	2e-16***
Wu-Hausman	1	5036	18.827	1.46e-05***
Sargan	1	NA	0.998	0.318
Diagnostics for GMM				
J-Test: degrees of freedom is 1				
Test E(g)=0:			J-test 3.77160	p-value 0.05213
Instrumented: financial literacy				
Instruments: language proficiency at 10, received care from family members				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions. The panel data includes WAVE 5(2013) and WAVE 6(2015)

We get similar results after removing Spain and Italy one at a time

An error of 0.00 is a rounded value

Standard errors are in parentheses

In our second econometric model in equation 2.5.2, we regress log saving against current financial literacy, two proxies of family ties and a vector of demographics. The results of this econometric model is in table 2.4. The coefficient of current financial literacy strengthens as we introduce family ties. Current financial literacy has a positive effect on savings. An increase in one standard deviation of financial literacy increases savings by 30%. When we apply instrumental variables and GMM, the positive effect of financial literacy on savings increases. In this model, we also add another instrument that is used by Jappelli and Padula (2013) which is the math proficiency at the age of 10. This instrument is validated by Jappelli and is used as an instrument in all the next regression models.

In addition, our first proxy for family ties which is frequency of contact with first child has a positive effect on savings at weak levels of family ties, and strong family ties (strong contact with first child) have a negative effect on savings. This result is similar to our first regression model. That is, at weak family ties (less than 4), an increase in ties increases savings by 58%. Moreover, at strong family ties (above 4), an increase in family ties will lower savings by 6%. The results are significant in the OLS regressions. When we apply instrumental variables, the results are similar and become statistically non-significant. However, the GMM show significant results of our first proxy for family ties. Overall, we conclude that financial literacy has a positive impact on savings, whereas family ties have a negative impact.

Our second proxy for family ties is the frequency of giving care to family members. The result is significant in the OLS and shows that the increase in frequency of family care lowers the savings by 18%. When we apply IV regression and GMM, the effect remains negative but statistically non-significant. Diagnostics of our Instrumental variables and GMM are presented in table 2.4.

It is clear that family ties have an effect on savings of individuals in our sample. Our first proxy for family ties shows that the effect of family ties on savings is positive at weak levels and is negative at strong levels. This result remains the same when we apply instrumental variables but becomes statistically non-significant. However, the GMM results are consistent with the OLS regressions and are significant. Our second proxy for family ties has a significant negative effect on savings. The estimates are consistent in the IV regression and GMM but are statistically non-significant. Financial literacy remains as a positive influence on savings and its results are consistent when we apply instrumental variables and GMM. We also present the interactions between financial literacy and our first proxy for family ties in affecting savings in figure 2.4.

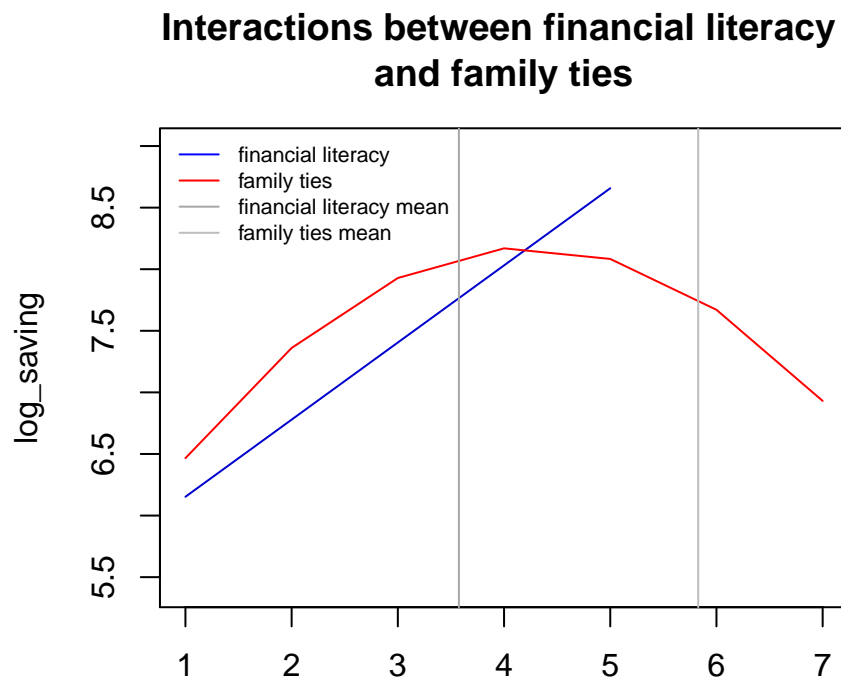


Figure 2.4: Interactions between financial literacy and our first proxy of family ties. The effect of financial literacy on savings is linear and positive. On the other hand, the effect of our first proxy of family ties on savings is non linear. Weak family ties (below 4) have a positive effect on savings. Strong family ties (above 4) are associated with less savings.

Table 2.5: Regression results for log investment
in complex financial instruments as dependent variable

	GMM	IV	OLS	OLS
financial literacy	0.97*** (0.36)	1.03*** (0.12)	0.42*** (0.03)	0.44*** (0.03)
contact with 1st child	0.79*** (0.27)	0.76*** (0.10)	0.85*** (0.09)	
contact with 1st child squared	-0.09*** (0.03)	-0.08*** (0.01)	-0.09*** (0.01)	
gave care to family	-6.17** (2.98)	-0.18** (0.08)	-0.22*** (0.08)	
education	0.01 (0.03)	0.08*** (0.01)	0.12*** (0.01)	0.12*** (0.01)
gender: male	-0.33 (0.24)	-0.00 (0.06)	0.20*** (0.05)	0.21*** (0.05)
log income	0.56*** (0.08)	0.35*** (0.02)	0.39*** (0.02)	0.39*** (0.02)
age	0.04*** (0.01)	0.03*** (0.00)	0.02*** (0.00)	0.03*** (0.00)
married, living with spouse	0.08 (0.36)	0.45*** (0.10)	0.51*** (0.10)	0.55*** (0.10)
married, not living with spouse	0.62 (0.70)	-0.07 (0.25)	-0.01 (0.25)	-0.01 (0.25)
never married	-0.93 (0.73)	0.33 (0.20)	0.32 (0.20)	0.30 (0.20)
registered partnership	-0.84 (0.85)	-0.42* (0.22)	-0.38* (0.22)	-0.38* (0.22)
widowed	-1.00** (0.48)	0.13 (0.13)	0.10 (0.13)	0.09 (0.13)
Criterion function	23.09			
R ²		0.05	0.06	0.06
Num. obs.	5064	29990	29990	29990
Diagnostics for IV regression				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	2	29962	790.944	2e-16***
Wu-Hausman	1	29962	27.989	1.23e-07***
Sargan	1	NA	3.782	0.0518
Diagnostics for GMM				
J-Test: degrees of freedom is 1			J-test	p-value
Test E(g)=0:			1.16931	0.27954
Instrumented: financial literacy				
Instruments: language proficiency at 10, received care from family members, math proficiency at 10				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions. The panel data includes WAVE 5(2013) and WAVE 6(2015)

We get similar results after removing Spain and Italy one at a time

An error of 0.00 is a rounded value

Standard errors are in parentheses

The third econometric model of equation 2.5.3 is similar to the previous one, but we use log investment as a dependent variable. log investment is a proxy for the respondents investment level in bonds, stocks and mutual funds. The results of this econometric model is in table 2.5. The results are very similar to the previous econometric model.

The coefficient of financial literacy is consistent when we introduce family ties in the OLS regression. In the OLS regression, an increase in one standard deviation of financial literacy increases investments by 42%. The effect of financial literacy increases as we introduce instrumental variables and GMM. The results are significant for financial literacy in its effect on investments in complex financial instruments.

In our first proxy for family ties which is frequency of contact with first child, weak family ties have a positive influence on investments and strong family ties have a negative influence on investments. At lower frequency of contact with first child (less than 4), an increase in family ties has a positive effect on investments. At weak levels of ties, an increase of 1 standard deviation results in an increase of 85% on investments. Also, at strong family ties (greater than 4), an increase in one standard deviation results in a decrease of 8% in investments. The results are significant. As we introduce IV regressions and GMM, the effect of our first proxy for family ties remains consistent and significant.

Our second proxy for family ties which is the frequency of giving care to family members, an increase in one standard deviation results in a negative effect of 18% on investments. When we apply IV regressions and GMM, the results remain consistent and significant. In addition, language skills at the age of 10, math proficiency at age of 10 and receiving care from family members are strong instruments. The Sargan statistics for the specification do not reject the over-identifying restrictions at the 1% level. The IV regression show that OLS regressions underestimate the effect of current financial literacy on savings and complex investment behavior. To add robustness to our models, we apply sub-sampling regressions by removing Spain and Italy, one at a time. The results are consistent with our findings. Diagnostics for Instrumental variables and GMM for this model are presented in table 2.5.

The results have shown similarity compared with the second econometric model. Financial literacy has a positive and significant effect on investments in complex financial instruments. Moreover, our first proxy for family ties has a positive effect on investments at weak levels and a negative effect on investments at strong levels. Results are significant. Also, the second proxy for family ties has a significant and negative effect on investments. The results remain significant

after we use IV regression and GMM.

Table 2.6: Regression results
for log wealth as dependent variable

	GMM	IV	OLS	OLS
financial literacy	0.82*** (0.14)	0.98*** (0.12)	0.25*** (0.01)	0.26*** (0.01)
contact with 1st child	0.38*** (0.07)	0.41*** (0.05)	0.52*** (0.04)	
contact with 1st child squared	-0.03*** (0.01)	-0.04*** (0.01)	-0.05*** (0.00)	
gave care to family	-0.26*** (0.07)	-0.17*** (0.04)	-0.22*** (0.04)	
education	-0.00 (0.01)	0.01 (0.01)	0.06*** (0.00)	0.06*** (0.00)
gender:male	-0.10* (0.06)	-0.21*** (0.05)	0.04* (0.02)	0.04 (0.02)
log income	0.34*** (0.02)	0.20*** (0.01)	0.24*** (0.01)	0.24*** (0.01)
age	-0.00 (0.00)	-0.00 (0.00)	-0.01*** (0.00)	-0.01*** (0.00)
married,living with spouse	0.86*** (0.08)	0.79*** (0.05)	0.87*** (0.05)	0.91*** (0.05)
married,not living with spouse	-0.04 (0.20)	-0.01 (0.12)	0.07 (0.11)	0.08 (0.11)
never married	0.01 (0.15)	-0.01 (0.10)	-0.02 (0.09)	-0.01 (0.09)
registered partnership	0.60*** (0.16)	0.32*** (0.11)	0.37*** (0.10)	0.36*** (0.10)
widowed	0.14 (0.11)	0.17*** (0.06)	0.14** (0.06)	0.16*** (0.06)
Criterion function	1.98			
R ²		0.08	0.12	0.11
Num. obs.	29990	29990	29990	29990
Diagnostics for IV regression				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	4	29960	790.944	2e-16***
Wu-Hausman	1	29962	27.989	1.04e-10***
Sargan	3	NA	6.779	0.0793
Diagnostics for GMM				
J-Test: degrees of freedom is 1			J-test	p-value
Test E(g)=0:			0.59265	0.44140
Instrumented: financial literacy				
Instruments: language proficiency at 10, received care from family members, math proficiency at 10, contact with family in social network				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions. The panel data includes WAVE 5(2013) and WAVE 6(2015)

We get similar results after removing Spain and Italy one at a time

An error of 0.00 is a rounded value

Standard errors are in parentheses

The fourth econometric model of equation 2.5.4 chooses log wealth as the dependent variable using the same independent variables as in econometric models 3 and 4. The results of the applied regressions are very similar to the previous 2 models and can be viewed in table 2.6. Again, financial literacy has a positive and significant impact on wealth.

In the OLS regression, an increase in one standard deviation of financial literacy increases wealth by 25%. When we apply instrumental variables and GMM, the impact of financial literacy becomes stronger on wealth. In addition, we find significant effects of family ties on wealth.

The results are consistent with our previous findings. At weak level of contact with first child, an increase in one standard deviation results in an increase in wealth. Also, at strong level of contact with first child, an increase in one standard deviation results in a decrease in wealth. Moreover, an increase of 1 standard deviation in giving care to family members results in a negative and significant effect on wealth. The results are consistent and significant when we apply IV regressions and GMM.

Our results are interesting because of the evident impact of family ties on savings, investment in complex financial instruments and wealth. This result leaves room for more studies on the determinants of financial behavior. As financial literacy is not the main driver of financial behavior, researchers apply different implementation of financial education programs to improve financial behavior.

Finally, the fifth econometric model of equation 2.5.5 uses log debt as the dependent variable with the same independent variables previously used. The results are presented in table 2.7. In the OLS regression, an increase in one standard deviation of financial literacy lowers the debt level by 8%. When we apply instrumental variables, the effect becomes stronger and remains significant where an increase in 1 standard deviation of financial literacy lowers debt by 24%. when we apply the GMM, the negative effect of financial literacy on debt becomes statistically non-significant. Our first proxy of family ties shows that at weak contact with first child, an increase in one standard deviation lowers debt by 16%. When we apply instrumental variables the effect of contact with first child on debt remains consistent. The results are significant. In addition, at strong contact frequency with the first child, an increase in one standard deviation results in an increase in debt by 1% and the result is significant. However, when we apply IV regression and GMM, the estimate remains consistent but statistically non-significant.

Our second proxy for family ties which is the frequency of giving care to family members leads to an increase in debt by 12%. The result is significant, however, as we introduce IV regression and GMM, the effect becomes statistically non-significant. The results are important because at strong family ties, individuals tend to have a higher load of debt. This finding can make room for financial education experiments to those who have strong family ties to improve debt behavior.

Table 2.7: Regression results
for log debt as dependent variable

	GMM	IV	OLS	OLS
financial literacy	-0.12 (0.21)	-0.24*** (0.09)	-0.08*** (0.02)	-0.09*** (0.02)
contact with 1st child	-0.18 (0.18)	-0.14* (0.07)	-0.16** (0.07)	
contact with 1st child squared	0.02 (0.02)	0.01 (0.01)	0.01* (0.01)	
gave care to family	-0.03 (0.13)	0.11 (0.07)	0.12* (0.06)	
education	0.02 (0.02)	0.01 (0.01)	0.00 (0.00)	0.00 (0.00)
gender:male	0.09 (0.14)	0.22*** (0.05)	0.16*** (0.04)	0.17*** (0.04)
log income	0.21*** (0.04)	0.03* (0.02)	0.02 (0.02)	0.02 (0.02)
age	-0.09*** (0.01)	-0.09*** (0.00)	-0.08*** (0.00)	-0.08*** (0.00)
married,living with spouse	-0.06 (0.24)	-0.25*** (0.08)	-0.27*** (0.08)	-0.28*** (0.08)
married,not living with spouse	0.23 (0.54)	0.19 (0.19)	0.18 (0.19)	0.17 (0.19)
never married	1.30** (0.61)	0.46*** (0.16)	0.47*** (0.16)	0.45*** (0.16)
registered partnership	1.34* (0.77)	0.48*** (0.17)	0.47*** (0.17)	0.48*** (0.17)
widowed	0.19 (0.25)	-0.02 (0.10)	-0.01 (0.10)	-0.03 (0.10)
Criterion function	15.99			
R ²		0.06	0.06	0.06
Num. obs.	5064	29990	29990	29990
Diagnostics for IV regression				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	2	29962	790.944	2e-16***
Wu-Hausman	1	29962	3024	0.082*
Sargan	1	NA	2.563	0.109
Diagnostics for GMM				
J-Test: degrees of freedom is 2				
Test E(g)=0:			J-test 0.80998	p-value 0.66698
Instrumented: financial literacy				
Instruments: language proficiency at 10, received care from family members, math proficiency at 10				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions. The panel data includes WAVE 5(2013) and WAVE 6(2015)

We get similar results after removing Spain and Italy one at a time

An error of 0.00 is a rounded value

Standard errors are in parentheses

The result of our empirical work states the following. Initial level of financial literacy is a determinant of the current level of financial literacy. Also, at strong level of family ties, individuals have lower financial literacy levels. This complies with our theoretical model that shows sub optimal financial literacy levels at strong family ties. Moreover, financial literacy is a main determinant of financial behavior. In addition, evidence of negative effect of strong levels of family ties on financial behavior (savings, investments, wealth and debt accumulation) shows that investment in financial literacy is not the main driver for improving financial behavior. These findings are in compliance with our theoretical model which shows that individuals with strong family ties acquire lower levels of wealth accumulation, savings and investments in complex financial instruments such as stocks. Also, individuals with strong family ties have higher levels of debt.

2.6 Conclusion and Recommendations

In previous papers, investing financial literacy is considered as a choice for individuals to improve their financial behavior. Opposed to that, other researchers find that, in comparison with cultural traits, financial literacy does not have a strong influence. No previous studies show the influence of family ties on financial literacy and financial behavior. In this paper, we consider financial literacy as a particular form of human capital accumulation that is influenced by the individual level of family ties. We propose an inter-temporal model to discuss the costs and benefits of financial literacy investment when the influence of family ties is present.

The model assumes that investing in financial literacy increases the net returns from inter-temporal trade, but requires money, time and effort. Moreover, the presence of stronger family ties increases the opportunity cost of investing in financial literacy. We show that the decision to acquire financial literacy depends on the same factors affecting the saving decisions. The model clarifies that financial literacy and savings are endogenous variables, and that the two variables are positively correlated. The model guides our estimation strategy, which relates measures of the stock of peoples' mathematical skills before entering the labor market and family ties to financial literacy later in life. Moreover, we find a negative effect of family ties on financial literacy and savings.

We validate our theoretical model with micro-economic data. We merge the Survey of Health, Aging, Retirement in Europe (SHARE) for individuals that age 50+ with SHARELIFE, a retrospective survey of the same individuals. In the first regression model, we find that financial literacy is strongly and positively correlated with the measure of mathematical

skills at school age of 10 available in SHARELIFE. This measure of mathematical skills at the age of 10 is used as a proxy for initial level of financial literacy in our paper. In our first econometric model, we use financial literacy as the dependent variable and three proxy measures of family ties, math skills at the age of 10 and a vector of demographics as independent variables. In our second econometric model, we use four proxy measures of financial behavior as dependent variables which are savings, investment in complex financial instruments such as stocks, wealth accumulation and debt accumulation. Our independent variables are financial literacy, three proxy measures of family ties and a vector of demographics. To analyze the data, we apply OLS, Instrumental Variables and GMM regressions.

In our first econometric model, we find that weak family ties have a strong and positive correlation with financial literacy and strong family ties have a negative correlation with financial literacy. When we run a two stage least squares regression model and Generalized Method of Moments, math skills at 10 show a consistent positive effect on financial literacy. Also, the strength of family ties show a significant and a strong negative effect on financial literacy.

In the remaining econometric model, we use four proxies for financial behavior as dependent variables (amount of savings, investment in complex instruments, wealth and debt accumulation). We find that financial literacy has a positive and significant effect on savings, investments and wealth. Also, we find that a higher level of financial literacy lowers the debt level of individuals. We also find that strong family ties can negatively influence savings, investments and wealth. On the contrary, at all levels, strong family ties raise the individual level of indebtedness.

In addition, we find that OLS underestimates the effect of the current financial literacy on savings, investment in complex instruments, wealth and debt accumulation. We propose an IV and GMM approach to address the endogeneity bias of family ties and financial literacy. We use verbal proficiency at the age of 10, frequency of receiving care from family members, frequency of family contact in social network and math skills at 10 as instrumental variables for financial literacy. OLS estimates tend to underestimate the correlation between the financial behavior proxies and financial literacy. In addition, the coefficient of family ties strength shows significance and negative effect in the IV regression on the financial behavior proxies. This finding shows that family ties should also be included in implementing financial education programs to improve financial behavior.

Overall, our evidence singles out two important determinants of financial literacy. The micro-economic data evi-

dence show that improving mathematical skills early in life eventually raises households' financial literacy and saving behavior. In addition, family ties show to be a determinant of the current stock of financial literacy. Strong family ties are associated with less financial literacy levels among individuals. Also, financial literacy and family ties are two important determinants of financial behavior and should not be ignored in the design and implementation of future financial education programs that aim at improving financial behavior.

The international comparison suggests that raising the incentive to invest in financial literacy may also lead to higher financial literacy and savings, keeping in mind that strong family ties can be a negative influence on investing in financial literacy. We recommend further studies that integrate family ties in financial literacy studies. A better proxy for family ties is recommended and other instruments for financial literacy and family ties are needed to provide a better evidence for the causality between family ties and financial literacy, the causality between financial literacy and financial behavior and the causality between family ties and financial behavior.

CHAPTER 3

Numeracy, psychological traits, cultural factors and financial socialization: Are they determinants of financial literacy?

Abstract

We present a comparative cross-region study that explains individual financial literacy level through demographic, psychological and cultural factors, where cultural and psychological factors are introduced for the first time in a financial literacy study to control for omitted variable bias. The main variables of our study are numeracy, financial socialization by parents, religiosity, family ties, confidence, impatience and geographic region. We produce a comprehensive survey that collects all these factors and is applied to 600 individuals across three geographic regions: Arabic, Germanic and Latin Europe (nine countries). The data is analyzed using OLS regression with country fixed effects, Instrumental Variables Regression, Generalized Method of Moments (GMM), Principal Component Analysis (PCA), and Principal Component Regression (PCR). The regression findings show that financial literacy is positively associated with numeracy, financial socialization, confidence and Germanic countries. In addition, financial literacy is negatively associated with family ties, religiosity, impatience, age and females. Moreover, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. The Artificial Intelligence techniques that are introduced for the first time in a financial literacy study which aim at providing a predictive approach to financial literacy determinants. Based on AI techniques using Regression Trees, Random Forest and Quantile Regression Forests, we find that financial literacy is mostly determined by geographic region, numeracy, impatience, confidence, financial socialization by parents, family ties and religiosity. These findings contribute to knowledge by suggesting new implementations of financial education program as an attempt to improve the effectiveness of financial literacy on financial behavior. These findings can be taken into consideration in constructing financial education programs that can be targeted towards focus groups based on gender, geographic region, age, level of religiosity, family ties, impatience and confidence.

Index terms— Financial Literacy, Psychological traits, Culture

3.1 Introduction

The riskier financial environment today demands the individual to be more engaged in financial knowledge to improve financial behavior (Lusardi and Mitchell, 2011c). In previous studies, financial literacy generates an improvement in wealth accumulation (Jappelli and Padula, 2013), retirement planning (Lusardi and Mitchell, 2011b; van Rooij et al., 2011a) and the ability to save and invest in complex financial instruments (Van Rooij et al., 2011b).

Financial literacy is viewed as a solution to tackle financial challenges and used in the development of financial education programs. Even though financial education programs may help individuals improve their financial situation, Gneezy et al. (2011) argue that the effect of financial literacy can be weak. That is, financial literacy may or may not have a positive effect on financial behavior. Hastings et al. (2013); Hira (2010); Adams and Rau (2011) and Fernandes et al. (2014) find that increasing financial literacy levels through financial education has a weak contribution to individual's financial behavior, and many individuals with high levels of financial literacy tend to have a weak financial behavior. The weak effects of financial literacy on financial behavior can be due to two main reasons: first, the measurement bias of financial literacy and second, omitted variable bias, which means that financial literacy measure may be inaccurate and may miss some of the relevant determinants (Hastings et al., 2013).

We contribute in the solving of both problems. Firstly, we contribute to the theoretical discussion and empirical work on financial literacy by using two different proxies to measure financial literacy. The measurement error of financial literacy which is associated with the difficulty to construct a robust operational definition and measurement methods of financial literacy.

There is an ongoing debate on the importance of numeracy as a determinant of financial literacy and financial behavior (Almenberg and Widmark, 2011; Banks, 2010; Estrada-Mejia et al., 2016). Moreover, researchers debate the value of entangling numeracy with financial literacy (Lusardi and Mitchell, 2011c). We control for the measurement error of financial literacy by comparing both: One proxy measure of financial literacy addresses four finance concepts such as inflation, diversification and interest rates, in line with (Kadoya and Khan, 2016). Another proxy measure of financial literacy uses a broader definition that includes numeracy as a part of financial literacy (Klapper et al., 2015). Hence, in our study, we operationally define financial literacy in two ways: (1) the ability to understand the implications of interest

rates, inflation and diversification; (2) the ability to understand the implications of numeracy, interest rates, inflation and diversification.

With regard to eventual omitted variable bias in influencing financial literacy, previous financial literacy studies limit the determinants of financial literacy to demographics, financial socialization by parents and numeracy (Lusardi and Mitchell, 2014a; Howlett et al., 2008; Gathergood and Weber, 2014), which makes the omitted variable bias prominent. To control for omitted variable bias, we extend the search on financial literacy determinants by introducing psychological and cultural factors. The literature suggests that psychological traits such as confidence and impatience are associated with higher academic achievement (Conard, 2006; Duckworth and Gross, 2014; Giunta et al., 2013; Ümmet, 2015). Moreover, previous studies suggest that family ties and religiosity have a significant effect on individual's economic attitudes (Renneboog and Spaenjers, 2012; Guiso et al., 2003; Alesina and Giuliano, 2014). The main argument of this paper is that financial literacy programs might not be effective because they are not addressing relevant variables in their design. We extend the prior financial literacy research by introducing cultural factors (family ties, religion and religiosity) and psychological traits (confidence and impatience) as determinants of financial literacy. and contribute to the comprehensive understanding of financial literacy.

We construct and apply a survey on financial literacy across nine countries (Lebanon, Syria, Palestine, Egypt, UAE, Germany, Holland, Portugal and Spain). Our aim is to cover three different regions: Arabic region (Lebanon, Syria, Palestine, Egypt, UAE), Germanic region (Germany and Holland) and Latin Europe (Portugal and Spain) to bring to evidence different cultural values; native languages, religiosity and family values and ties. The Arabic region (1) hosts the birth of monotheistic religions: Judaism, Christianity and Islam (2) has strong family ties according to the World Values Survey (WVS) and (3) includes Arabic speaking countries. The Germanic region (Germany and Holland) (1) is the main contributor to the rise of Protestantism, (2) has distinctive cultural values and according to the World Value Survey (WVS), has weak family ties and (3) the native language is Germanic. Finally, the Latin region covers Portugal and Spain that (1) have a Catholic background, (2) stronger family ties, according to the World Values Survey, and (3) are Latin-speaking countries. These three regions provide a proper sample to control the main variables interest.

A survey that addresses the dimensions of financial literacy, demographics, financial socialization by parents, numeracy, cultural (family ties, religion and religiosity) and psychological traits (confidence and impatience) is applied and

600 proper responses are collected for analysis.

To analyze this data, we apply Ordinary Least Squares (OLS) regressions using country fixed effects, Instrumental Variable regressions (IV), Generalized Method of Momentum (GMM), Principal Component Analysis (PCA) and Principal Component Regression (PCR). Moreover, we apply Artificial Intelligence using machine learning algorithms for the first time in financial literacy studies. The algorithms we use are Regression Trees, conditional Random Forests and Quantile Regression Forests to predict the most important independent variables in explaining financial literacy.

The dependent variable is financial literacy (two measures) and our independent variables are financial socialization by parents, numeracy (in one of the econometric models), religiosity, family ties, confidence, impatience, business/economics studies at the university and a vector of demographics.

Applying OLS regression using country fixed effects, Instrumental Variable regressions and Generalized Method of Moments, Principal Component Analysis and Principal Component Regression, we show that financial literacy, numeracy, financial socialization by parents, confidence, education and Germanic countries have a positive effect on financial literacy. The results are significant over the different regressions. However, family ties, religiosity, impatience and age show a negative and significant effect on financial literacy.

The AI techniques lie in applying machine learning algorithms such as Regression Trees, Random Forest and Quantile Regression Forests. Using these three machine learning algorithms, the results show that numeracy, geographic region, confidence, financial socialization by parents, family ties and religiosity are the main determinants of financial literacy. The results are consistent across the different techniques used and the results are suitable for constructing a financial literacy program by geographic region and cultural differences to improve the financial behavior of individuals.

Our contribution to financial literacy literature takes different forms. Firstly, we introduce new variables as suggested determinants of financial literacy, which are religiosity, family ties, confidence and impatience. Secondly, we use two proxy measures of our dependent variable, which is financial literacy to entangle/disentangle numeracy from financial literacy. Thirdly, our sample selection is unique and is based on cultural differences such as family ties, religiosity levels and language diversity. In addition, another contribution to financial literacy studies is the application of Artificial Intelli-

gence (AI) techniques to support our regression and principal component analysis. The advantage of using AI algorithms lies in their ability to predict the determinants of financial literacy and rank them by importance.

Finally, our findings contribute to the knowledge by suggesting new ways to implement financial education programs that can improve the financial behavior of individuals. Our findings show that financial literacy is negatively associated with family ties, religiosity, impatience, age and Gender. Constructing financial education programs adjusted to the individual level of family ties, religiosity, impatience, age and gender can be a solution to gain effective results on financial behavior. In addition, our findings show that financial socialization, numeracy, confidence and geographic region have a positive effect on financial literacy. We suggest that improving math knowledge in schools can help individuals better understand financial concepts. In addition, educating parents on financial concepts and motivating them to teach their children about financial concepts at a younger age can help in improving financial behavior. Moreover, we suggest that financial education programs should be implemented in different ways based on country diversities. The variables suggested in our study are hard to control for in financial education programs. However, we recommend that the findings be taken into consideration in the construction of financial education programs with the overall aim of raising financial literacy levels among individuals.

The remainder of the paper is organized as follows. Section 2 presents the current literature on financial literacy, numeracy, cultural factors and psychological traits. Section 3 describes the methodology selected. Section 4 presents the econometric estimates and machine learning algorithms selected, using micro-economic data. Section 5 concludes.

3.2 Literature review

In this section we discuss relevant financial literacy literature and how it is related to numeracy, financial socialization by parents, psychological traits and cultural factors that are included in our study.

3.2.1 Financial Literacy, Financial Socialization and Numeracy

Financial literacy is defined in different ways, with all the definitions taking a conceptual or operational form. According to the President's Advisory Council on Financial Literacy (PACFL, 2008) financial literacy is the ability to use knowledge and skills to manage financial resources effectively for a lifetime of well-being. This definition is adopted from the Jump\$

coalition's definition. Moreover, the US Financial Literacy and Education Commission of 2007 and the Organization for Economic Co-operation and Development (OECD, 2013) define financial literacy as the ability and awareness to use knowledge and skills to manage financial resources to achieve maximum financial well-being.

With the presence of different conceptual and operational definitions of financial literacy, there is a lack of a standard and agreed definition to be used by researchers is and a needed tool to help develop effective financial education programs. A major weakness of financial literacy research is that it is conducted with widely varying conceptualizations, dimensions and measures of the concept (Huston, 2010).

To measure financial literacy, a set of three financial literacy questions are added by Lusardi and Mitchell (2011a) to the Health and Retirement Study in 2004. The "big three" questions cover three financial concepts which are compound interest; real rates of return and risk diversification. Two additional questions were added to "the big 3" by Hung et al. (2009) and thus become "the big 5". The two additional questions are used to test knowledge of mortgage interest and bond prices.

There is an ongoing debate about whether "the big 3" or "the big 5" financial literacy measures are valid. Financial literacy measurement error may be due to over reliance on these financial literacy measures and the measurement error may be attributed to reliance on an invalid proxy measure, which can lead to a biased measurement of financial literacy. Moreover, there is an ongoing debate whether numeracy should be entangled with financial literacy measures at all. Separating financial literacy from concepts such as numeracy and cognitive abilities is evident in the literature and is also attributed to measurement error of financial literacy. To disentangle numeracy from financial literacy, Grohmann et al. (2015) only use numeracy as a determinant of literacy. However, numeracy is endogenized using education quality as an instrument for numeracy. In our study, to control for measurement error, we use numeracy as both a proxy measure for financial literacy and as a determinant of financial literacy.

The lack of a unified way of measuring financial literacy in previous studies can be attributed to measurement error of financial literacy. In order to better measure financial literacy, we define financial literacy in two ways: (1) an individual's knowledge of compound interest, inflation and risk diversification (2) an individual's knowledge of numeracy, compound interest, inflation and risk diversification, after we endogenize with numeracy. The application of these defi-

nitions makes financial literacy a uni-dimensional variable that is easy to measure. Moreover, by relying on two proxies to measure financial literacy, with and without numeracy, we control for the measurement error, that is prominent in previous financial literacy studies.

Another weakness of financial literacy studies is the presence of reverse causality where numeracy can be a determinant of financial literacy and vice versa (Grohmann et al., 2015). In our study, we control for the reverse causality problem of financial literacy by endogenizing numeracy using instrumental variables which are the "need for cognition" (Fernandes et al., 2014), language proficiency, math skills at the age of 10 (Jappelli and Padula, 2013) and parental education (mother and father) (Behrman, Mitchell, Soo and Bravo, 2012).

In previous studies, the choice determinants of financial literacy are demographics, financial socialization and numeracy. Researchers have sought to identify which demographic variables such as country, gender, location, age, ethnicity and occupation have been associated with financial literacy. These demographics results have been used in the selection of individuals for whom financial education programs are effective.

Gender gaps in financial literacy are empirically evident. Financial literacy is observed to be lower in females (Lusardi and Mitchell, 2011c; Van Rooij et al., 2011b; Bucher-Koenen et al., 2017; Lusardi and Tufano, 2015). In a world-wide study, Klapper et al. (2015) show that women are less financially literate than men in 135 out of 144 countries. While the lower financial literacy level maybe attributed to married women who rely on their husband's financial knowledge, this explanation is negated by evidence of low financial literacy scores among single and financially independent women (Grohmann et al., 2016). Gender gaps in financial literacy may also be attributed to the lower levels education, income and exposure in financial affairs, in addition to gender inequalities (Mahdavi and Horton, 2014).

Age is also a factor in financial literacy. According to Lachance and Choquette-Bernier (2004), people tend to learn from their mistakes and become more knowledgeable with time. That is, the higher the age, the higher the expected level of financial literacy. However, Lusardi et al. (2017); Lusardi and Mitchell (2011b,c) and Bucher-Koenen and Lusardi (2011) have shown a hump shaped level of financial literacy with increased age, which shows that people tend to lose some of their financial literacy after retirement possibly due to the loss of cognitive skills or less need for financial literacy.

The education level of the individual and their spouse also affect financial literacy (Grohmann et al., 2015; Lusardi and Mitchell, 2011*b,c*). According to behavioral economic theories that are in favor of cognitive abilities, education has a positive impact of education on financial literacy (Gill and Prowse, 2016; Lusardi et al., 2010). Moreover, social learning theories purport the effect of spouse or parent education level on the individual's level of financial literacy. Empirically, parents' education level influences their children's financial literacy (Mahdavi and Horton, 2014). In addition, financial socialization by parents, numeracy and business/economics education lead to a higher level of financial literacy among individuals (Grohmann et al., 2015; Mahdavi and Horton, 2014; Almenberg and Widmark, 2011).

Numeracy, demographics and financial socialization by parents explain a part of the gap in financial literacy levels among individuals and should be used in constructing financial education programs that aim to improve financial behavior. However, relying solely on numeracy, demographics and financial socialization by parents may lead to omitted variable bias in measuring the determinants of financial literacy. In the next section, we present our additional choice independent variables to control for omitted variable bias.

3.2.2 Psychological and Cultural Factors

Accordingly, financial literacy, along with some psychological and cultural factors can better explain financial behavior (Hastings et al., 2013) (Fernandes et al., 2014) and (Borghans and Golstyn, 2006) and other economic outcomes (Renneboog and Spaenjers, 2012; Guiso et al., 2003; Chen, 2013). In addition, psychological and cultural traits may solve for the omitted variables problem that makes financial literacy incapable of fully explaining the financial behavior of individuals.

However, no previous studies use psychological traits as a determinant of financial literacy. Yet, personal traits and self-efficacy are empirically associated with academic achievement (Caprara et al., 2011; Giunta et al., 2013; Conard, 2006). From this perspective and to control for omitted variable bias, we introduce personal traits as determinants of financial literacy. The proxies we choose for personal traits as determinants of financial literacy are confidence and impatience.

Meier and Sprenger (2013) find that impatience is identified as a psychological factor that influences financial literacy and in turn financial behavior as patient people tend to make better financial decisions. Impatience is measured by how willing an individual is to prioritize the future over the present. Impatience is used as a determinant of financial behavior in financial literacy studies and it will be used in our study as a determinant of financial literacy.

As a proxy for the discount factor, Duckworth and Gross (2014) find that self-control is associated with higher academic achievement. In addition, Gathergood and Weber (2014) show that impatience is associated with lower financial literacy levels and poor financial behavior.

Another psychological and self-efficacy trait is confidence in finding financial information, which encompasses the proactive use and processing of financial information and decision-making (Bearden et al., 2001). In a study by Caprara et al. (2011), confidence is associated with higher educational achievement. In our study, we include confidence and impatience as determinants of financial literacy.

Researchers explore the effect of culture on economic outcomes (Guiso et al., 2003), however, no previous studies exclusively study the impact of cultural traits on financial literacy. To explain the rationale behind the importance of cultural traits in determining financial literacy, we discuss some economic aspects of religion, religiosity, family ties and native language differences.

Finance is an important subject in religion and is clearly referenced in the holy books of monotheistic religions. In Weber (1904)'s *The Protestant Ethic and Spirit of Capitalism*, he attributes the birth of capitalism to Protestantism, and specifically Calvinism. Recent studies suggest that religiosity has a significant effect on individual's economic attitudes such as trust in non-family members, planning and saving in the Netherlands (Renneboog and Spaenjers, 2012) and (Guiso et al., 2003). Renneboog and Spaenjers (2012) use of religious affiliation as the way to measure religiosity. In previous studies, Protestants have stronger social ethics (Arrunada, 2010) where as Catholics are more able to control their subjective well-being than Protestants (Renneboog and Spaenjers, 2012).

As no studies to date have introduced religiosity as a determinant of financial literacy, the literature already uses religion as a determinant of academic achievement. Davis (2014) discusses the child's perception towards education

in the pre and post-secular world and finds that educational achievement is more dominant in a post secular world. With no previous studies about the effect of religiosity on financial literacy, the previously discussed findings show that religion and religiosity may add up to be the factors that can influence financial literacy.

In a cultural study, Alesina and Giuliano (2014) observe the effect of family ties on economic outcomes and find that strong family values are linked with lower political participation and action, lower trust levels to strangers, more interest in job security, less desire for innovation, and conservative attitudes toward working women. Little attention is given to the family as a relevant variable that explains financial literacy and economic outcomes. According to Banfield (1958) and Coleman and Coleman (1994), societies that are based on strong ties among family members, tend to promote good conduct only within small circles related to family and kin. On the other hand, societies that are based on weak ties among family members are willing to promote good conduct among circles that are outside family and kin. This intuition is confirmed by (Gambetta, 1988). Therefore, we introduce family ties as a potential determinant of financial literacy.

To summarize, religiosity and family ties influence economic outcomes and these cultural factors are used for the first time in a financial literacy study to test their effect on individual financial literacy.

3.3 Methodology

We use a micro-economic cross sectional data set with information on financial socialization by parents, numeracy, religiosity, family ties, impatience, confidence, as determinants of financial literacy measures and among other demographic variables. The survey is made of 59 closed-ended questions and is filled in anonymously. The data is drawn from the survey collected from three different regions, where religion, family ties levels and native language differ. The survey is conducted in three languages (Portuguese, Spanish and English). We use the English questionnaire for the Arabic region, Germany and Holland. We use an English questionnaire in Germany and Holland because English is a Germanic language. Also, according to Gordon Jr (2005), 90% of the Dutch, 56% of German and 45% of Lebanese population can speak in English. In addition, 50% of the Lebanese schools and 70% of the Lebanese universities use English as a language of instruction. In Lebanon, only 10% of schools teach in Arabic, which negates the need for an Arabic questionnaire. We acknowledge the limitation of distributing a questionnaire in English to non-native English

speaking countries is a limitation and that results are restricted to our sample and survey language selection.

The first region is the Middle East where we collect our Arabic sample. The majority of the Arabic sample is from Lebanon, which diverse religiosity and culture compared to other countries across the region. The Middle East is chosen as a sub-sample because (1) it witnesses the birth of the main three monotheistic religions, Christianity, Islam and Judaism; (2) family ties are considered strong based on the World Values Survey (WVS) and (3) the native language including Arabic speaking countries is suitable for our cultural study.

The second region is Latin Europe and the selection of respondents is from Spain and Portugal. We choose Spain and Portugal because of (1) their Catholic background; (2) family ties in Spain and Portugal are the strongest in comparison with other European countries according to the World Values Survey and (3) these countries speak a Latin native language which can be suitable for our comparative cultural study.

The third region is Northern Europe where we collect responses from Germany and Holland. Germany and Holland (1) host the birth of Protestantism and, based on World Values Survey (WVS), (2) show weak family ties compared to other countries and (3) speak a Germanic native language.

Before we run our analysis, we apply Propensity Score Matching that eliminates observations that do not match with the distribution of the variables across our geographic sub-samples. In our study, Propensity Score Matching is used to reduce the selection bias by balancing the characteristics of the participants across our geographic regions. This will shrink our samples from 717 to 643 observations. In addition, we eliminate the observations from countries that do not belong to our Geographic sub-samples. This narrows our sample from 643 to 600 observations.

H0 : There is no effect of numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics on financial literacy

H1 : There is an effect of numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics on financial literacy

H0 : There is no effect of math skills at the age of 10, financial socialization by parents, family ties, religiosity,

confidence and impatience on cumulative financial literacy

H1 : There is an effect of math skills at the age of 10, financial socialization by parents, family ties, religiosity, confidence and impatience on cumulative financial literacy

H0 : There is no order of importance of numeracy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining the level of financial literacy

H1 : There is an order of importance of numeracy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining the level of financial literacy

H0 : There is no order of importance of math skills at the age of 10, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining the level of cumulative financial literacy

H1 : There is an order of importance of math skills at the age of 10, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience) and demographics in determining the level of cumulative financial literacy

We run OLS regressions using country fixed effects, IV regressions, GMM, Principal Component Analysis and Principal Component Regression. In addition, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. We use two proxies of financial literacy for our dependent variables and our independent variables of choice are numeracy (in econometric model 3.3.1), financial socialization by parents, cultural factors (religiosity, family ties), psychological factors (impatience, confidence) and a vector of demographics. The empirical models are formulated below.

$$finlit_i = \alpha + \beta_1 numeracy_i + \beta_2 finsoc_i + \beta_3 ties_i + \beta_4 religiosity_i + \beta_5 impatience_i + \beta_6 confidence_i + \beta_7 X'_i + \varepsilon_i \quad (3.3.1)$$

Where *finsoc* is financial socialization, *ties* is family ties and *X'* is a vector of demographics.

$$\begin{aligned} cumfinlit_i = & \alpha + \beta_1 math10_i + \beta_2 finsoc_i + \beta_3 ties_i + \\ & \beta_4 religiosity_i + \beta_5 impatience_i + \beta_6 confidence_i + \beta_7 X'_i + \varepsilon_i \end{aligned} \quad (3.3.2)$$

Where *math10* is math skills at the age of 10, *finsoc* is financial socialization, *ties* is family ties and *X'* is a vector of demographics.

In model 3.3.1, we use a financial literacy score independent from numeracy. In model 3.3.2, we use a cumulative financial literacy score that is integrated with numeracy. Our cultural variables are religiosity and family ties. Moreover, our psychological variables are impatience and confidence. The demographics are business/economics major at the university, age, gender, marital status, religion, education, geographic region and household income. A detailed explanation about measuring and aggregating our dependent and independent variables are presented in section 3.4.1 of the appendix.

We use OLS regressions with country fixed effects in the regression models. Country fixed effects are used in the OLS to control for omitted variable bias. To control for endogeneity, we use Instrumental Variables (IV) regressions and the endogenous variables we choose are financial socialization by parents (Grohmann et al., 2015), numeracy (Estrada-Mejia et al., 2016) and confidence (Ümme, 2015). In this paper, we are controlling for endogeneity due to the problem of measurement error of financial literacy. IV regression is also suitable for omitted variable bias which is a challenge in financial literacy studies. Our endogenous variable is numeracy and the instruments we choose are parental education, math at 10, need for cognition and language proficiency (Grohmann et al., 2015; Fernandes et al., 2014; Behrman, Mitchell, Soo and Brava, 2012; Ümme, 2015). In addition, to treat the heteroskedasticity problem, we also run a GMM model. GMM is also helpful for robustness checks. To have a clearer view on why we choose to use these techniques, a detailed explanation is available in section 2.5.1 in chapter 2.

We also run a Principal Component Analysis and Principal Component Regression due to the multi-dimensionality of the study. PCA and PCR are highly suitable for high dimensional data just like ours. Our dependent variable is financial literacy and, in this model, we include every question related to our independent variables in the PCA. This methodology

is used to reduce dimensions of the model. After we reduce the dimensions, we run PCR on the selected components in order to measure the coefficients of each variable affecting financial literacy.

Principal Component Analysis (PCA) is a dimension-reduction tool that can be used to reduce a large set of variables to a smaller set that still contains the most relevant information in the large set. Principal Component Analysis is a mathematical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables called principal components. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. Traditionally, Principal Component Analysis is performed on a square symmetric matrix. It can be a SSCP matrix (pure sums of squares and cross products), covariance matrix (scaled sums of squares and cross products), or correlation matrix (sums of squares and cross products from standardized data). The analysis results for objects of type SSCP and covariance do not differ, since these objects only differ in a global scaling factor. A correlation matrix is used if the variances of individual variates differ much, or if the units of measurement of the individual variates differ (Jolliffe, 2003).

PCA is used for the following reasons: it can reduce the number of variables, but is not able to identify variables to completely remove from consideration, ensuring that our variables are independent of one another and ensures that independent variables are less interpretable. Due to our multi-dimensionality problem in our data set which is due to many questions regarding different variables, we use Principal Component Analysis to reduce the dimensionality of our data set. On the other hand, the data reduction makes our data less interpretable. To solve this problem, we use Principal Component Regression (PCR). In PCR, we first perform Principal Component Analysis (PCA) on the original data, then perform dimension reduction by selecting the number of principal components m using cross-validation or test set error, and finally conduct regression using the first m dimension reduced principal components.

Principal Component Regression forms the derived input columns $z_m = X_{vm}$ and then regresses y on z_1, z_2, \dots, z_m for some $m \leq p$. Principal components regression discards the $p-m$ smallest eigenvalue components.

By manually setting the projection onto the principal component directions with small eigenvalues set to 0, dimension reduction is achieved. PCR is very similar to ridge regression in a certain sense. Ridge regression can be viewed

conceptually as projecting the y vector onto the principal component directions and then shrinking the projection on each principal component direction. The amount of shrinkage depends on the variance of that principal component. Ridge regression shrinks everything, but it never shrinks anything to zero. By contrast, PCR either does not shrink a component at all or shrinks it to zero (Jolliffe, 2003).

We apply Principal Component Regression so we can interpret the beta estimates of every variable in the selected principal components. The result will be a reduced dimensionality of the data and an ability to interpret the effect of our explanatory variables on our dependent variable. In our study, we apply PCA and PCR to reduce the dimensionality of our data, to make sure our variables are independent and to add robustness to our OLS, IV Regression and GMM results. Because we have the luxury of reducing a highly dimensional data, we use every question used as a proxy to measure our variables in our Principal Component Analysis. After we reduce our data to a selected number of principal components, we regress these principal components using PCR, so we can interpret the coefficient of every variable used in the data. We also apply PCA and PCR in chapter 4.

Applying AI techniques is a different approach that can predict the determinants of financial literacy by importance. While most financial literacy studies use standard regression models, we believe that machine learning algorithms provide another insight on the determinants of financial literacy. We propose using three popular machine learning algorithms that suit our data set. The first algorithm we use is Regression Trees, which is suitable for continuous dependent variables. In addition, we add robustness by using an unconditional Random Forest algorithm that is more accurate as it averages out a selected number of Regression Trees. Finally, we apply Quantile Regression Forests, which can predict Regression Trees at different quantiles. We run three machine learning algorithms and base our results on the algorithm with the lowest mean square error.

The first machine learning algorithm we use is Classification and Regression Trees. Classification and Regression Trees are machine learning methods for constructing prediction models from data. The models are obtained by recursively partitioning the data space and fitting a simple prediction model within each partition. As a result, the partitioning can be represented graphically as a decision tree. Classification trees are designed for dependent variables that take a finite number of unordered values, with prediction error measured in terms of misclassification cost. Regression Trees are for dependent variables that take continuous or ordered discrete values, with prediction error typically measured by the squared difference between the observed and predicted values (Breiman, 2017).

In a classification problem, we have a training sample of n observations on a class variable Y that takes values $1, 2, \dots, k$ and p predictor variables, X_1, X_2, \dots, X_p . The goal is to find a model for predicting the value of Y from new X values. In theory, the solution is a partition of the X space into k disjoint sets, A_1, A_2, \dots, A_k , such that the predicted value of Y is j if X belongs to A_j , for $j = 1, 2, \dots, k$. If the X variables take ordered values, two classical solutions are linear discriminant analysis and nearest neighbor classification. These methods yield sets of A_j with piecewise linear and nonlinear, respectively, boundaries that are not easy to interpret in p is large.

Classification tree methods yield rectangular sets A_j by recursively partitioning the data set one X variable at a time. This makes the sets easier to interpret. The classification tree algorithms used in our study are CART (classification and regression trees) (Breiman, 2017) and RPART (recursive partitioning) (Therneau and Atkinson, 2008). The RPART and CART algorithm pseudo-code is:

- (1) Start at the root node.
- (2) For each ordered variable X , convert it to an unordered variable X' by grouping its values in the node into a small number of intervals. If X is unordered, set $X' = X$.
- (3) Perform a chi-squared test of independence of each X' variable versus Y on the data in the node and compute its significance probability.
- (4) Choose the variable X^* associated with the X' that has the smallest significance probability. (5) Find the split set $\{X^* \in S^*\}$ that minimizes the sum of Gini indexes and use it to split the node into two child nodes.
- (6) If a stopping criterion is reached, exit. Otherwise, apply steps 2–5 to each child node. (7) Prune the tree with the CART method.

A regression tree is similar to a classification tree, except that the Y variable takes ordered values and a regression model is fitted to each node to give the predicted values of Y . The CART regression tree method has the following pseudo-algorithm.

- (1) Start at the root node.
- (2) For each X , find the set S that minimizes the sum of the node impurities in the two child nodes and choose the split $\{X^* \in S^*\}$ that gives the minimum overall X and S .

(3) If a stopping criterion is reached, exit. Otherwise, apply step 2 to each child node in turn.

With the node impurity being the sum of squared deviations about the mean and the node predicting the sample mean of Y , this yields piecewise constant models. Although they are simple to interpret, the prediction accuracy of these models often lags behind that of models with more smoothness. It can be computationally impracticable, however, to extend this approach to piecewise linear models, because two linear models (one for each child node) must be fitted for every candidate split (Breiman, 2017).

In this study, we apply Regression Trees because our dependent variable is numeric. The purpose of using Regression Trees is to add robustness to our previous techniques, in addition to finding the order of importance of our selection of independent variables in affecting financial literacy.

In addition to regression and classification trees, we apply ensemble learning, which consists of methods that generate many classifiers and aggregate their results. Two well-known methods are boosting (Schapire et al., 1998) and bagging (Breiman, 1996) of classification trees. In boosting, successive trees give extra weight to points incorrectly predicted by earlier predictors. In the end, a weighted vote is taken for prediction. In bagging, successive trees do not depend on earlier trees, where each is independently constructed using a bootstrap sample of the data set. In the end, a simple majority vote is taken for prediction. Breiman (2001) has proposed Random Forests, which add an additional layer of randomness to bagging. In addition to constructing each tree using a different bootstrap sample of the data, Random Forests change how the classification or Regression Trees are constructed. In standard trees, each node is split using the best split among all variables. In a Random Forest, each node is split using the best among a subset of predictors randomly chosen at that node. This somewhat counter intuitive strategy end up performing well compared to many other classifiers, including discriminant analysis, support vector machines and neural networks, and is robust against over-fitting (Breiman, 2001). In addition, it is very user-friendly in the sense that it has only two parameters (the number of variables in the random subset at each node and the number of trees in the forest), and is usually not very sensitive to their values.

Random Forest grows an ensemble of trees, using n independent observations (Y_i, X_i) , $i = \{1, \dots, n\}$. A large number of trees is grown. For each tree and each node, Random Forests employs randomness when selecting a

variable to split on. For each tree, a bagged version of the training data is used.

The prediction of a single tree $T(\phi)$ for a new data point $X = x$ is obtained by averaging over the observed values in leaf $\ell(x, \phi)$. Let the weight vector $w_i(x, \phi)$ be given by a positive constant if observation X_i is part of leaf $\ell(x, \phi)$ and 0 if it is not. The weights sum to one, and thus:

$$w_i(x, \phi) = \frac{1_{\{X_i \in R_{\ell(x, \phi)}\}}}{\#\{j: X_j \in R_{\ell(x, \phi)}\}}$$

The prediction of a single tree, given covariate $X = x$, is then the weighted average of the original observations $Y_i, i = 1, \dots, n$,

$$\text{single tree: } \hat{\mu}(x) = k^{-1} \sum_{i=1}^k Y_i$$

Using Random Forests, the conditional mean $E(Y|X = x)$ is approximated by the averaged prediction of k single trees, each constructed with an independent and identically distributed vector $\theta_t, t = 1, \dots, k$. Let $w_i(x)$ be the average of $w_i(\theta)$ over this collection of trees,

$$w_i(x) = k^{-1} \sum_{t=1}^k w_i(x, \theta_t)$$

The prediction of Random Forest is then:

$$\text{Random Forest: } \hat{\mu}(x) = \sum_{i=1}^n w_i(x) Y_i$$

The approximation of the conditional mean of Y , given $X=x$, is thus given by a weighted sum over all observations. The weights vary with the covariate $X=x$ and tend to be large for those $i \in \{1, \dots, n\}$, where the conditional distribution of Y , given $X=X_i$, is similar to the conditional distribution of Y , given $X=x$.

The Random Forest algorithm (for both classification and regression) is as follows:

(1) Draw n_{tree} or number of trees bootstrap samples from the original data.

- (2) For each of the bootstrap samples, grow an unpruned classification or regression tree, with the following modification: at each node, rather than choosing the best split among all predictors, randomly sample " m_{try} " or the number of the predictors and choose the best split from among those variables. Bagging can be thought of as the special case of Random Forests obtained when $m_{try}=p$, the number of predictors.
- (3) Predict new data by aggregating the predictions of the n_{tree} or the number of trees. That is, the majority votes for classification, average for regression.

An estimate of the error rate can be obtained, based on the training data, by the following: (1) At each bootstrap iteration, predict the data not in the bootstrap sample, this is what Breiman (2001) calls "out-of-bag", or OOB, data using the tree grown with the bootstrap sample. (2) Aggregate the OOB predictions. On the average, each data point would be out-of-bag around 36% of the times, so we aggregate these predictions. Then, we calculate the error rate, and call it the OOB estimate of error rate. The previous experience has been that the OOB estimate of error rate is quite accurate, given that enough trees have been grown (otherwise the OOB estimate can bias upward (Bylander, 2002)).

In our study, we apply the Random Forest algorithm to our primary data set. We apply this algorithm for the following reasons: (1) Add robustness to our previous techniques, (2) Predict the explanatory variables that influence our dependent variables by importance, and (3) use a different approach than the classical regression methods previously used in financial literacy studies.

We also use one more machine learning algorithm, which is Quantile Regression Forests. The reason for using three machine learning algorithms is for comparison purpose. We select the best prediction of our three algorithms based on the lowest mean square error.

Quantile Regression Forests provide a non-parametric and accurate way of estimating conditional quantiles for high-dimensional predictor variables, where conditional quantiles can be inferred with Quantile Regression Forests, to make a generalization of Random Forests. The key difference between Quantile Regression Forests and Random Forests is as follows: for each node in each tree, Random Forest keeps only the mean of the observations that fall into this node and neglects all other information. In contrast, Quantile Regression Forests keep the value of all observations in this node, not just their mean, and assesses the conditional distribution based on this information. We explain the predictor of

quantile regression below (Meinshausen, 2006).

Random Forest approximates the conditional mean $E(Y|X = x)$ by a weighted mean over the observations of the response variable Y . One could suspect that the weighted observations deliver not only a good approximation to the conditional mean but to the full conditional distribution. The conditional distribution function of Y , given $X=x$, is given by

$$F(y|X = x) = P(Y \leq y|X = x) = E(1_{Y \leq y}|X = x)$$

The last expression is suited to draw analogies with the Random Forest approximation of the conditional mean $E(Y|X = x)$. Just as $E(Y|X = x)$ is approximated by a weighted mean over the observations of Y , define an approximation to $E(1_{Y \leq y}|X = x)$ by the weighted mean over the observations of $1_{Y \leq y}$,

$$\hat{F}(y|X = x) = \sum_{i=1}^n w_i(x) 1_{Y_i \leq y}$$

Using the same weights $w_i(x)$ as for Random Forests, defined in this equation:

$$w_i(x) = k^{-1} \sum_{t=1}^k w_i(x, \theta_t)$$

This approximation is at the heart of the Quantile Regression Forests algorithm.

The algorithm for computing the estimate $\hat{F}(y|X = x)$ can be summarized as:

a) Grow k trees $T(\theta_t)$, $t = 1, \dots, k$, as in Random Forests. However, for every leaf of every tree, we take note of all observations in this leaf, not just their average.

b) For a given $X = x$, drop x down all trees. Compute the weight $w_i(x, \theta_t)$ of observation $i \in 1, \dots, n$ for every tree as the weights sum to one. Compute weight $w_i(x)$ for every observation $i \in 1, \dots, n$ as an average over $w_i(x, \theta_t)$, $\{t = 1, \dots, k\}$, as in the following equation:

$$w_i(x) = k^{-1} \sum_{i=1}^k w_i(x, \theta_t).$$

c) Compute the estimate of the distribution function as in the following equation $\hat{F}(y|X = x) = \sum_{i=1}^n w_i(x) 1_{Y_i \leq y}$ for all $y \in \mathfrak{R}$, using the weights from Step b).

Estimates $\hat{Q}_\alpha(x)$ of the conditional quantiles $Q_\alpha(x)$ are obtained by plugging $\hat{F}(y|X = x)$ instead of $F(y|X = x)$ into $Q_\alpha(x) = \inf y : F(y|X = x) \geq \alpha$.

In addition to the robustness Artificial Intelligence can add to our study, the machine learning algorithms we use, Regression Trees, Random Forest and Quantile Regression Forests analysis, can predict the determinants of financial literacy by importance. To conclude, we use these three machine algorithms to (1) control for our highly dimensional data, (2) add robustness to our previous techniques such as OLS regression with fixed effects, Instrumental Variables regression, Generalized Method of Moments, Principal Component Analysis and Principal Component Regression and (3) predict the rank of importance of our independent variables in affecting financial literacy. The three machine learning algorithms are also applied in chapter 4.

3.4 Data Description

The survey is written and translated in three languages, English, Spanish and Portuguese. It is pre-tested by fifteen academics before its distribution to respondents. To check for the reliability of the questions, we conduct a Cronbach alpha test and find that the questions have an alpha between 0.59 and 0.66 which shows the validity of our questions to be included in our analysis.

The data consists of 717 observations collected between February and October 2017 using Google Forms. The questionnaire was circulated in three languages (English, Portuguese and Spanish) and the Google Forms links was distributed through university email lists, social media and word of mouth. We use the English questionnaire for the Arabic region, Germany and Holland. The reason we use an English questionnaire in Germany and Holland is because English is a Germanic language and English proficiency levels are very high (Gordon Jr, 2005), with Germany ranked

first and Holland ranked ninth using the English Proficiency Index. In addition, Lebanon which dominates our Arabic sub-samples uses English as the language of instruction in schools and universities. After removing respondents that do not belong to our chosen geographic regions, the sample shrinks from 717 to 674. Then we eliminate the observations that do not belong to the distribution of the variables across the three Geographic regions using Propensity Score Matching. In our study, Propensity Score Matching is used to reduce the selection bias by balancing the characteristics of the participants across our geographic regions. Using Propensity Score Matching, 30 observations are dropped from the Arabic sub-sample, 23 observations are dropped from the Latin European sub-sample and 21 observations are dropped from the Germanic sub-sample. The final selected sample consists of 600 observations. The residual standard error of the regression on the matched data is lower than the error of the original data. Our data has three sub-samples based on geographic regions. The Arabic categorical region has 300 observations, the Germanic regions has 149 observations and the Latin European region has 151 observations. Because of the discrepancy between the three sub-samples, we run power analysis to find the sample size needed for this comparative study. At a significance level of 5% and an estimation power of 85%, the number of observations needed for every group is 66. Therefore, our sub-samples have enough observations for this comparative study.

3.4.1 Dependent and independent variables

Our dependent variable is a proxy for financial literacy. We use two ways of constructing a financial literacy score. The first proxy is a financial literacy score excluding the numeracy and the second proxy is a financial literacy score including numeracy. In our survey, respondents are presented with four financial literacy questions based on our definition of financial literacy which is one question about the knowledge about diversification, one question on inflation and two questions on interest rates as used by (Klapper et al., 2015).

The financial literacy questions are stated below.

- Question 1 (diversification): Suppose you have some money. Is it safer to put your money into one business or investment, or to put your money into multiple businesses or investments?
- Question 2 (inflation): Suppose over the next 10 years the prices of the things you buy double. If your income also doubles, will you be able to: buy less than you can buy today, the same as you can buy today, or more than you can buy today?

- Question 3 (interest rates): Suppose you put money in the bank for two years and the bank agrees to add 15 percent per year to your account. Will the bank: add more money to your account the second year than the bank did the first year, or will the bank add the same amount of money both years?
- Question 4 (interest rates): Suppose you had 100 US dollars in a savings account and the bank adds 10 percent per year to the account. How much money would you have in the account after five years if you did not remove any money from the account?

From these questions, a financial literacy score of 1 to 5 has been constructed. The answers to these questions are combined into a summary indicator similar to (Jappelli and Padula, 2013).

If the inflation question is wrong, respondent gets 1 and is directed to the question about diversification, if the diversification question is answered correctly, the respondent gets a score of 2. If the diversification question is answered incorrectly, the respondent will get a score of 1. If the inflation question is answered correctly, the respondent gets 3 and if the 2 questions about interest rates are answered correctly, then the respondent gets 1 point on each question and getting a score of 5. If one of the interest rate questions is answered correctly, the respondent gets a score of 4 and if both interest rate questions are answered incorrectly, the respondent will get a score of 3. This is our measure of financial literacy.

We also construct another measure of cumulative financial literacy that integrates numeracy. The cumulative financial literacy score is the sum of our constructed financial literacy and numeracy scores. This measure is used as dependent variable in our study.

We use three numeracy questions to construct a numeracy score that is independent of financial literacy. Moreover, we also use these numeracy questions as a part of a cumulative financial literacy score. The numeracy score will be used as an independent variable in our study. The numeracy questions are presented below.

- (smaller amount) Suppose you need to borrow 100 euros. Which is the lower amount to pay back: 105 euros or 100 euros plus three percent?
- (discount) The regular price of a shirt in Zara is 40 euros. How much will you pay for this Zara shirt if you get a sales discount of 35%? 5, 21, 26, or 35 euros?

- (cheaper bottle) If a 500 ml of Head and Shoulders shampoo bottle costs 5 euros and a 750 ml of Head and Shoulders shampoo bottle costs 8 euros, which bottle will you buy if you only want to pay less for Head and Shoulders shampoo?

If the discount question is wrong then the individuals get 1 point and then directed to the cheaper bottle question. If the cheaper bottle question is answered correctly, then the respondent gets an additional 1 point, and thus, get a score of 2.

If the discount question is answered correctly, the respondent gets 3 points. If the respondent then answers the cheaper bottle and smaller amount questions correctly, then the respondent get an additional point on every correct questions and thus earning a score of 5.

Another measure of numeracy used is the individual's subjective math level at the age of 10 (5 point Likert) (Jappelli and Padula, 2013). This measure is a good proxy for the initial level of individual numeracy because level 10 math approached addition, subtraction, multiplication, division, problems, numbers and measures. Math at age of 10 has been used in WAVE SHARE across country European data set and has been used in financial literacy studies such as (Jappelli and Padula, 2013).

The measurement of this variable is made using the following 5 point Likert question with 1 being much worse and 5 being much better: At the age of 10, how did you perform in maths compared to other children in your class?

We construct a measure of financial socialization by parents using two 5 point Likert scale questions The financial socialization score is constructed by adding the results of the following two questions: (Grohmann et al., 2015).

- My parents taught me how to budget and manage my pocket money
- My parents encouraged me to save money when I was between 12 and 16 years old

Most of the parents have believed that children between age of 12 and 16 are ready to be involved in family finances (Danes, 1994). Financial socialization by parents is used as an independent variable in our study.

Using three questions (5 point Likert) from the World Values Survey (WVS), we construct our proxy for family ties.

- In my life, my family means everything to me

- Regardless of what the qualities and faults of one's parents are, one must always love and respect them
- It is the parents' duty to do their best for their children even at the expense of their own well-being

We aggregate the three family ties questions to construct a family ties variable.

We also construct a measure of religiosity by aggregating two 5 point Likert scale questions using the World Values Survey (WVS).

- I go to church, mosque or other place of worship (1=never and 5=always)
- I consider myself to be a religious person (1=strongly disagree, 5=strongly agree)

To construct a proxy for impatience, we aggregate three 5 point Likert scale questions based on (Gathergood and Weber, 2014).

- I am impulsive and tend to buy things even when I don't really need them
- I am impulsive and tend to buy things even when I can't really afford them
- I am prepared to spend money now and let the future take care of itself To measure confidence, we use five close ended questions that follow a 5 point Likert scale. We then sum up the score of all the questions to construct our proxy for confidence. A measure of confidence has been constructed by Bearden et al. (2001) and has been used by (Fernandes et al., 2014).
- I am confident in my ability to recognize a good financial investment
- I know what investments to look for to get the most return on my money
- I know the right questions to ask when making financial investment decisions
- I have the skills required to make proper financial investments
- I know the right tools sources such as friends, colleagues, financial advisers and media to consult to make wise financial decisions

The demographic variables chosen are age, gender, marital status, religion, household income, geographic region and if the individual studied business/economics at the university. The education categories chosen are high school or less, university student, university graduate and post graduate. The religion categories selected are "Christian", "Muslim" and "Other".

The geographic region variable includes "Arabic", "Latin Europe", "Germanic". The household income categories are "less than 500 euros", "500-1000 euros", "1001-1999 euros", "2000-3999 euros" and "above 4000 euros". Finally marital status includes "Single", "Married" and "Other".

In our sample, we focus on three geographic regions, Germanic, Arabic and Latin European countries. The Germanic sub-sample includes Germany and Holland. The Arabic sub-sample includes Lebanon, Syria, Egypt, Tunis and Palestine. Finally, the Latin European sub-sample includes Portugal and Spain. The respondents from other countries are labeled as "Others" and are dropped from the sample. Our choice independent variables are numeracy, math skills at the age of 10, financial socialization by parents, family ties, religiosity, impatience and confidence. Our dependent variable is financial literacy.

3.4.2 Descriptive Statistics

We present some descriptive statistics for our variables of choice. Figure 3.1 shows that financial literacy scores are the highest in the Germanic sub sample with a mean of 4.5, a minimum of 2 and a maximum of 5 out of 5. Arabic sub sample is ranked second with a mean of 3.4 and Latin European sub sample is ranked third with a mean of 3.2. The Germanic region has a high mean score of financial literacy which is consistent with the rank of financial literacy score by country (Klapper et al., 2015). The results are slightly different using our second measure of financial literacy, which include the numeracy levels of individuals, with a closer cumulative financial literacy levels between Arabic and Latin European regions. The Germanic region is also ranked first on our cumulative financial literacy score with a mean of 9.1. The Latin European region has a score of 7.5 and the Arabic region has a score of 7.3. We attribute these results strictly to our sample as some discrepancies may have been introduced due to the use of the English language questionnaire in the Arabic region.

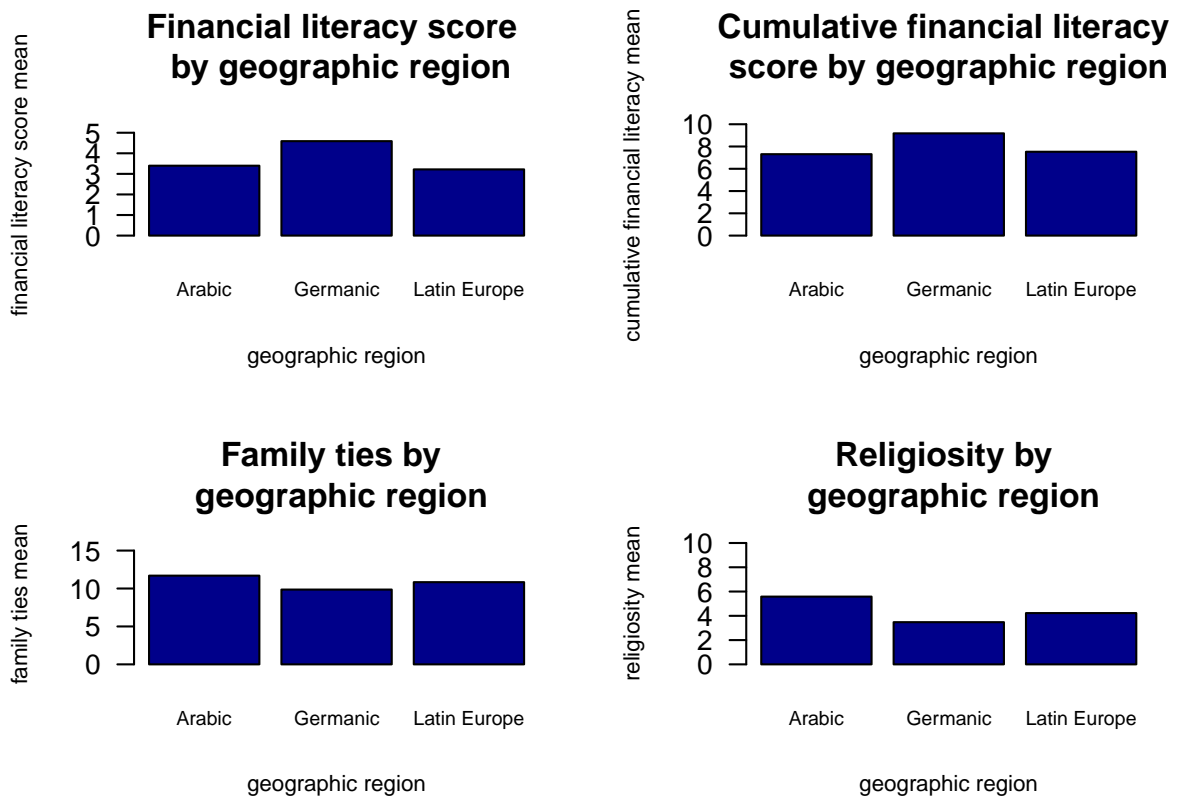


Figure 3.1: Financial literacy, religiosity and family ties by geographic region

Similar to financial literacy scores, Germanic respondents have the highest level of numeracy with a mean of 4.5 over 5. Unlike financial literacy, Latin European respondents have higher numeracy scores than Arabic respondents. This shows that financial literacy is not the only determinant of financial literacy.

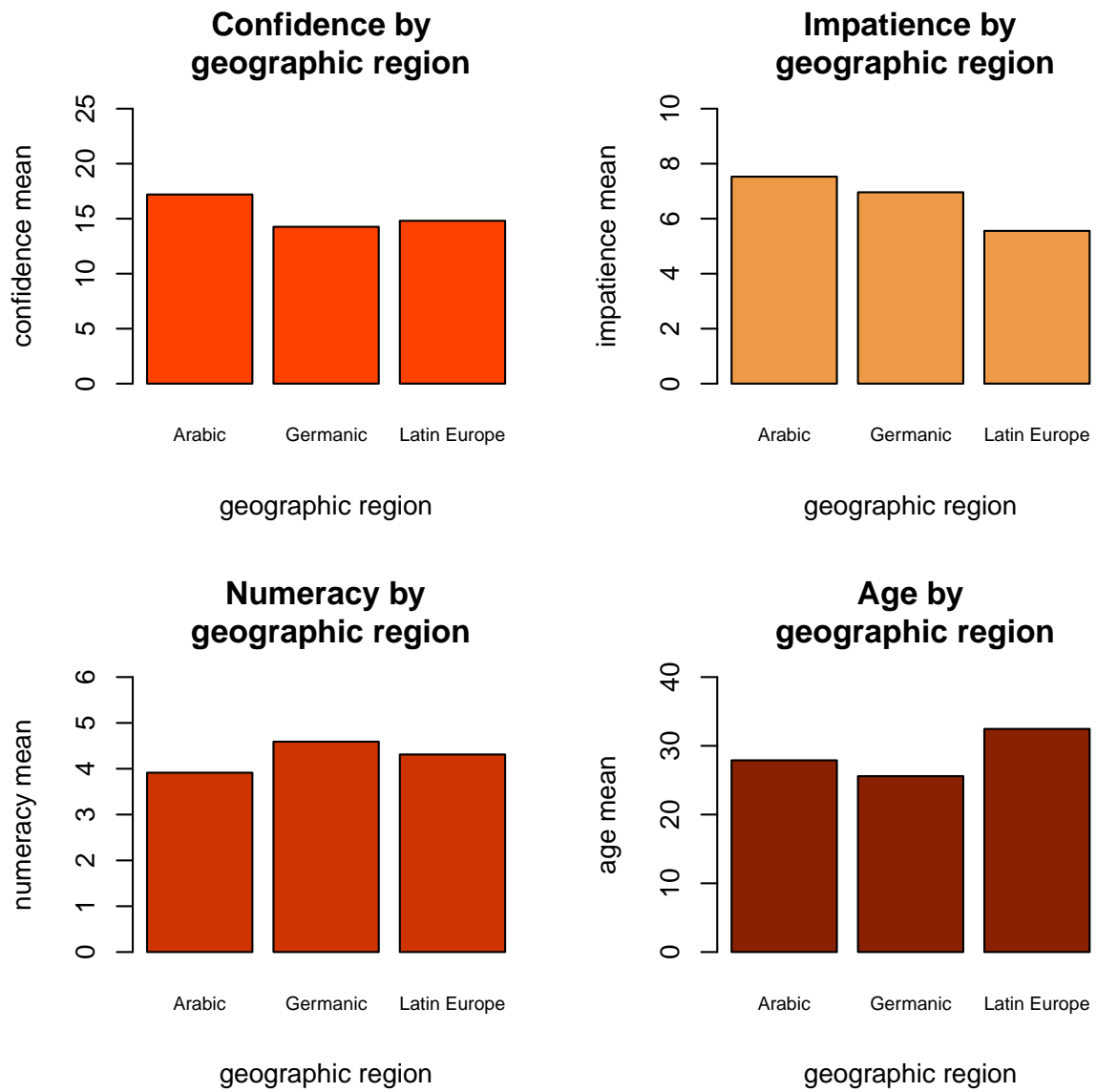


Figure 3.2: Numeracy, age, confidence and impatience by geographic region

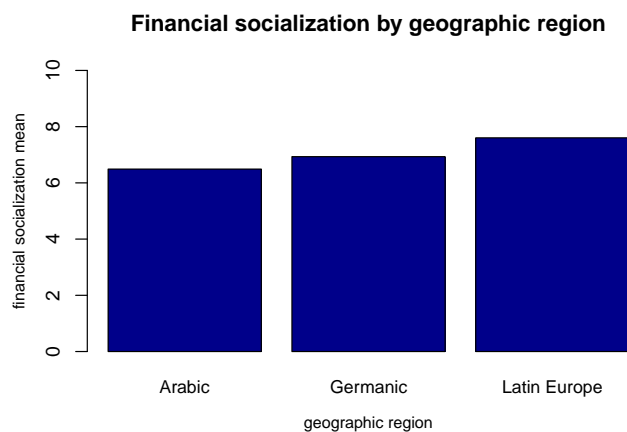


Figure 3.3: Financial socialization by geographic region

In figure 3.1, we note that religiosity is highest in Arabic countries and family ties are also highest in Arabic countries. Germanic countries have the lowest family ties and religiosity levels. More descriptive statistics are available in section B.1 of the appendix.

Table 3.1: Descriptive statistics of the continuous variables

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	600	4.182	1.202	1	5
financial socialization by parents	600	6.880	2.130	2	10
financial literacy	600	3.648	1.435	1	5
financial literacy with numeracy	600	7.830	2.102	2	10
math at 10	600	3.862	0.956	1	5
religiosity	600	4.717	2.387	2	10
family ties	600	11.022	2.429	3	15
confidence	600	15.867	4.219	5	25
impatience	600	6.890	2.846	3	15
age	600	28.467	8.317	16	70
language proficiency	600	2.683	0.497	1	3
need for cognition	600	18.365	3.676	5	25

Table 3.2: Descriptive statistics of the continuous variables in the Arabic region

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	300	3.913	1.341	1	5
financial socialization by parents	300	6.490	2.130	2	10
financial literacy	300	3.397	1.479	1	5
cumulative financial literacy	300	7.310	2.244	2	10
math at 10	300	3.833	0.994	1	5
religiosity	300	5.580	2.179	2	10
family ties	300	11.693	2.414	3	15
confidence	300	17.197	3.772	5	25
impatience	300	7.527	2.969	3	15
age	300	27.890	7.675	16	70
language proficiency	300	2.707	0.456	2	3
need for cognition	300	17.627	3.681	5	25

Table 3.3: Descriptive statistics of the continuous variables for the Latin European region

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	151	4.311	1.053	1	5
financial socialization by parents	151	7.603	2.139	2	10
financial literacy	151	3.219	1.346	1	5
cumulative financial literacy	151	7.530	1.921	3	10
math at 10	151	3.675	0.837	2	5
religiosity	151	4.225	2.403	2	10
family ties	151	10.834	2.051	5	15
confidence	151	14.808	4.231	5	25
impatience	151	5.556	2.416	3	15
age	151	32.457	10.193	19	61
language proficiency	151	2.563	0.549	1	3
need for cognition	151	18.801	3.691	5	25

Table 3.4: Descriptive statistics of the continuous variables for the Germanic region

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	149	4.591	0.870	1	5
financial socialization by parents	149	6.933	1.927	2	10
financial literacy	149	4.591	0.930	2	5
cumulative financial literacy	149	9.181	1.220	6	10
math at 10	149	4.107	0.945	2	5
religiosity	149	3.477	2.075	2	10
family ties	149	9.859	2.351	3	15
confidence	149	14.262	4.223	5	21
impatience	149	6.960	2.536	3	14
age	149	25.584	5.514	16	57
language proficiency	149	2.758	0.502	1	3
need for cognition	149	19.409	3.331	11	25

3.5 Data Analysis

We present our analysis using multiple regressions, Principal Component Analysis, Principal Component Regression and Artificial Intelligence.

3.5.1 Regression Analysis

In this section, we present our results using OLS regressions with country fixed effects, IV regression and Generalized Method of Momentum.

Before running the regression, we test for multi-collinearity and ensure that all independent variables have a VIF below four which shows no multi-collinearity in the model. To gain more robustness in our results, we apply country fixed effects, IV regressions and generalized method of momentum. Instrumental variables are applied to control for the endogeneity of confidence, numeracy and financial socialization. The instruments we use are: need for cognition, parental education (mother and father) and language proficiency. The GMM model is applied to control for the heteroscedasticity problem. The Breusch-Pagan test gives a p-value of 0 which shows a heteroscedasticity problem. In addition, the residuals in our econometric model are normally distributed. The results and diagnostics are in tables 3.5 and 3.6.

In table 3.5, numeracy has a positively significant coefficient and is consistent as we introduce our culture and psychological variables in the OLS regressions. In the OLS regression, an increase in one standard deviation of numeracy raises financial literacy by 0.19 standard deviations and the result is significant. Similar to the previous empirical findings, individuals with higher numeracy levels are more financially literate. However, when we apply IV regressions and GMM, the numeracy effect on financial literacy remains positive but it weakens and becomes statistically non-significant. That is, in the IV regression an increase in one standard deviation in numeracy, raises financial literacy by 0.12 standard deviations and the result is statistically non-significant. In addition, the GMM shows that an increase in one standard deviation in numeracy, raises financial literacy by 0.06 standard deviations and the result is statistically non-significant. This positive effect of numeracy on financial literacy is consistent with previous findings.

Financial socialization shows a negative effect on financial literacy in the OLS regression and the results are statistically non-significant. In the IV regression, financial socialization becomes significant with a negative effect on financial literacy. This is analogous to the previous findings of (Grohmann et al., 2015). However, the GMM shows that the effect of financial socialization on financial literacy is positive and statistically non-significant. That is, an increase in one standard deviation in financial socialization raises financial literacy by 0.12 standard deviations and the result is statistically non-significant. This result of having a positive effect of financial socialization by parents on financial literacy complies with the previous empirical findings.

The cultural variables in our study are family ties and religiosity. In the OLS, our proxy of family ties shows an statistically non-significant negative effect on financial literacy. When we apply IV regressions and GMM, our proxy for family ties becomes significant. The results show that, holding things constant, an increase in one standard deviation in family ties lowers financial literacy by 0.14 standard deviations. The result is significant. Moreover, religiosity does not show significance in the regression models. In the OLS models, religiosity has a negative and statistically non-significant coefficient. In the GMM, the coefficient of religiosity becomes positive but remains statistically non-significant. In the GMM, *ceteris paribus*, an increase in one standard deviation in religiosity raises financial literacy by 0.02 standard deviations. The result is statistically non-significant. These are new findings due to the lack of engagement of cultural factors as determinants of financial literacy in previous research.

When it comes to our psychological variables, impatience shows a significant and negative effect in the OLS re-

gressions. In the OLS, an increase in one standard deviation in impatience lowers financial literacy by 0.05 standard deviations and the result is significant. The effect remains negative but becomes statistically non-significant in the IV regression. However, in the GMM, the effect of impatience on financial literacy is negative and significant. In the GMM, an increase in one standard deviation in impatience lowers financial literacy by 0.05 standard deviations and the result is significant. In addition, confidence shows a positive and statistically non-significant effect in the OLS regressions. Yet, the IV regression and GMM show that confidence is positively significant. That is, in the GMM, an increase in one standard deviation of confidence raises financial literacy by 0.22 standard deviations and the result is significant. These findings are also new in research related to finding the determinants of financial literacy. Previous works have not included psychological traits as determinants of financial literacy.

In terms of demographics, individuals from our Germanic sample (Germany and Holland) are significantly more financially literate than the other sub-samples. This results complies to previous global financial literacy studies. In addition, Muslims show lower levels of financial literacy compared to Christians. Males have higher financial literacy levels compared to females and the result is significant in the OLS regressions but not in the IV regression and GMM. In the OLS regression, males have a higher financial literacy than females and the result is significant. In the GMM, males still perform better than females in financial literacy but the result becomes statistically non-significant.

We also run a regression that includes an interaction between religiosity and religion in our sample. The interaction plot is presented in figure 3.4. We find a negative effect of religiosity on financial literacy among Muslims and a positive effect of religiosity on financial literacy among Christians and those of other religions. The overall effect of religiosity on financial literacy is positive. The difference may be attributed to the level of encouragement of engaging in financial literacy in religious practices.

In addition, we run an interaction between religion and geographic region to find how Christians' levels of financial literacy vary across our three geographic regions. The diagnostics in table 3.6 show that the instrumented variables are endogenous, the instruments chosen are valid and no over-identification is detected. Our instrumented variables are confidence, numeracy and financial socialization. Our choice of instruments are parental education, need for cognition and language proficiency.

To ensure more robustness to our results, we apply regression after removing a geographic region sub-sample one at a time from the regressions. The results are consistent with the previous findings.

As a second step, we apply our regression using our second proxy of financial literacy as the dependent variable. This proxy adds three numeracy questions to the financial literacy questions. Cumulative financial literacy has a score from 1 to 7 and is applied similarly to that of (Jappelli and Padula, 2013).

Columns 4, 5 and 6 in table 3.5 show the OLS regressions using country fixed effects, IV regression and GMM results for our second proxy of financial literacy, which we call cumulative financial literacy. Our GMM and Instrumental Variable regression diagnostics using cumulative financial literacy are presented in table 3.6. Math skills at the age of 10 are used as an additional independent variable and have a positively significant coefficient of 0.41 in the OLS regressions. When we apply IV regression and GMM, the effect of math skills at the age of 10 on cumulative financial literacy weakens but remains positively significant. In the GMM, one standard deviation increase in math skills at the age of 10 raises cumulative financial literacy by 0.35 standard deviations. This result shows that math skills at the age of 10 are positively related to the cumulative financial literacy of individuals. The result is similar to previous empirical findings.

Table 3.5: Results for financial literacy using fixed effects, IV regression and generalized method of momentum

	Financial Literacy			Cumulative Financial Literacy		
	GMM	IV	OLS	GMM	IV	OLS
numeracy	0.06 (0.19)	0.12 (0.30)	0.19*** (0.05)			
math at 10				0.35*** (0.10)	0.28*** (0.10)	0.41*** (0.08)
financial socialization	0.12 (0.17)	-0.17 (0.21)	-0.02 (0.03)	0.45* (0.25)	0.10 (0.27)	-0.06 (0.04)
family ties	-0.14*** (0.04)	-0.10** (0.04)	-0.01 (0.03)	-0.08 (0.06)	-0.06 (0.06)	0.06 (0.04)
religiosity	0.02 (0.03)	0.04 (0.04)	-0.02 (0.03)	-0.04 (0.05)	-0.01 (0.05)	-0.05 (0.04)
impatience	-0.05** (0.02)	-0.03 (0.02)	-0.05** (0.02)	-0.04 (0.03)	-0.05 (0.03)	-0.07** (0.03)
confidence	0.22*** (0.06)	0.27*** (0.07)	0.02 (0.02)	0.13 (0.09)	0.25** (0.10)	0.05** (0.02)
age	0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)	0.02 (0.02)	0.01 (0.02)	0.01 (0.01)
gender: male	0.14 (0.18)	-0.07 (0.23)	0.27** (0.12)	0.50** (0.24)	0.28 (0.29)	0.39** (0.17)
business/economics at university: yes	-0.07 (0.23)	-0.38 (0.28)	0.22* (0.13)	0.65* (0.34)	0.23 (0.36)	0.60*** (0.18)
education: Post graduate	0.14 (0.28)	-0.03 (0.26)	0.17 (0.21)	0.04 (0.39)	-0.00 (0.33)	0.17 (0.30)
education: University graduate	0.37 (0.29)	0.20 (0.27)	0.31 (0.22)	0.14 (0.39)	0.09 (0.34)	0.22 (0.31)
education: University student	0.20 (0.29)	0.09 (0.27)	0.20 (0.22)	0.14 (0.39)	0.14 (0.35)	0.26 (0.31)
geographic region: Germanic	1.04*** (0.28)	-0.21 (0.26)	-0.15 (0.20)	1.34*** (0.39)	-0.15 (0.33)	-0.04 (0.29)
geographic region: Latin Europe	-0.46 (0.33)	-0.45 (0.31)	-0.10 (0.23)	-0.50 (0.51)	-0.23 (0.40)	-0.03 (0.33)
religion: Muslim	-0.51** (0.22)	-0.61** (0.26)	-0.33* (0.19)	-0.74** (0.29)	-0.84*** (0.31)	-0.49* (0.27)
religion: Other	0.18 (0.18)	0.13 (0.20)	0.05 (0.16)	0.13 (0.21)	0.24 (0.25)	0.18 (0.22)
household income: 2000-3999	0.53*** (0.19)	0.73*** (0.20)	0.59*** (0.14)	0.29 (0.24)	0.58** (0.25)	0.56*** (0.20)
household income: 500-1000	0.33* (0.18)	0.42** (0.20)	0.50*** (0.16)	0.22 (0.24)	0.30 (0.26)	0.33 (0.23)
household income: less than 500	0.30 (0.32)	0.41 (0.33)	0.39* (0.23)	-0.50 (0.39)	-0.33 (0.37)	-0.31 (0.32)
household income: more than 4000	0.28 (0.22)	0.51** (0.21)	0.71*** (0.17)	0.59** (0.29)	0.61** (0.27)	0.87*** (0.24)
marital status: Other	0.34 (0.35)	0.32 (0.38)	0.34 (0.30)	0.65 (0.49)	0.41 (0.48)	0.35 (0.43)
marital status: Single	-0.08 (0.19)	-0.02 (0.20)	0.06 (0.15)	0.30 (0.25)	0.22 (0.24)	0.33 (0.22)
Criterion function	3574.86			2374.00		
R ²		0.04	0.13		0.10	0.17
Adj. R ²		-0.01	0.08		0.04	0.13
Num. obs.	600	600	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions

We get similar results after removing our sub-samples one at a time

Standard errors are in parentheses

Table 3.6: Diagnostics of financial literacy IV Regression and GMM in table 3.5

Diagnostics for IV regression of financial literacy				
	df1	df2	statistic	p-value
Weak instruments (numeracy)	15	556	2.782	3.56e-04***
Weak instruments (financial socialization)	15	556	1.877	2.29e-02*
Weak instruments (confidence)	15	556	4.940	4.94e-09***
Wu-Hausman	3	565	9.872	2.37e-06***
Sargan	12	NA	14.828	0.25099

Diagnostics for GMM of financial literacy			
J-Test: degrees of freedom is 13			
		J-test	p-value
Test E(g)=0:		20.7136	0.0787
Instrumented: confidence, financial socialization Instruments: math at 10, mother education, father education, need for cognition, language proficiency			

Diagnostics for IV regression of cumulative financial literacy				
	df1	df2	statistic	p-value
Weak instruments (financial socialization)	14	556	1.799	3.56e-02*
Weak instruments (confidence)	14	556	3.860	2.71e-06***
Wu-Hausman	2	566	6.932	1.06e-03**
Sargan	12	NA	11.222	0.51003

Diagnostics for GMM of cumulative financial literacy			
J-Test: degrees of freedom is 13			
		J-test	p-value
Test E(g)=0:		15.9804	0.2501
Instrumented: confidence, financial socialization Instruments: mother education, father education, need for cognition, language proficiency			

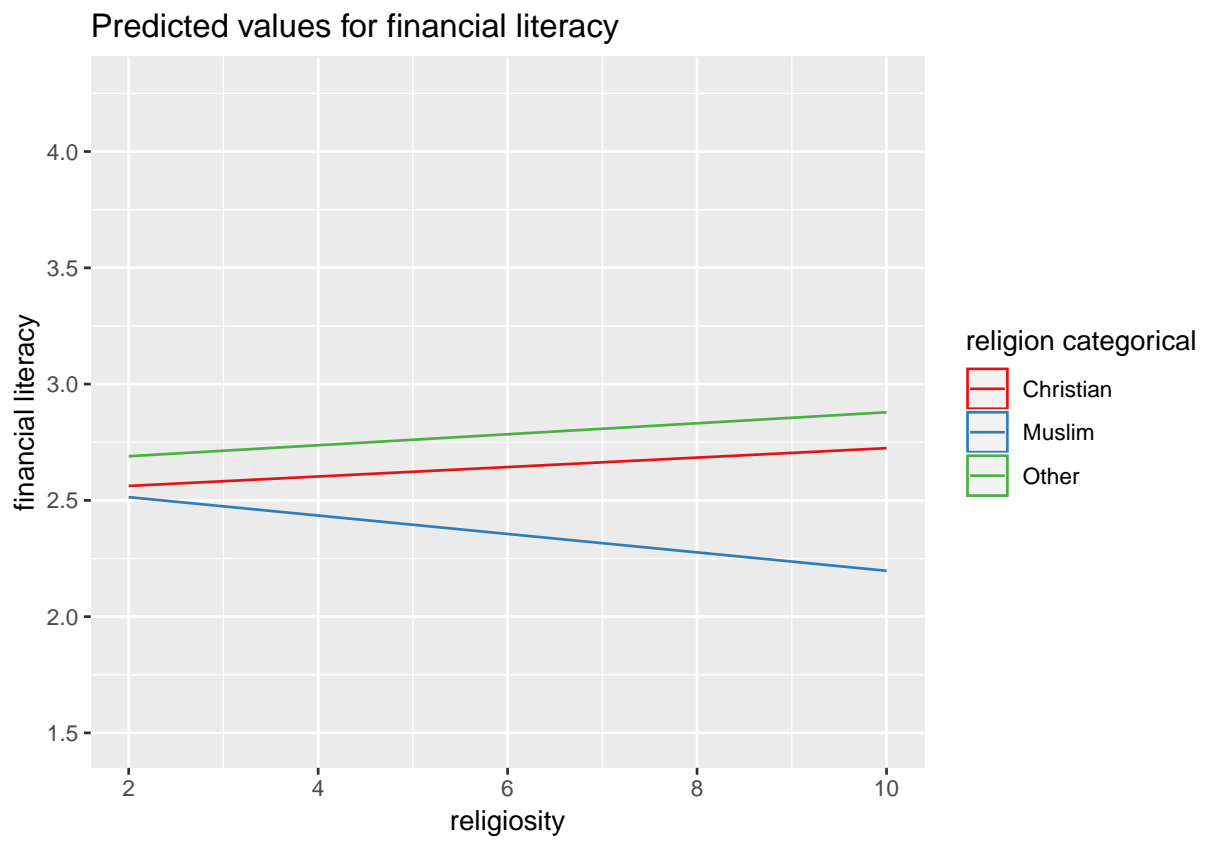


Figure 3.4: Interaction margins plot between religiosity and religion

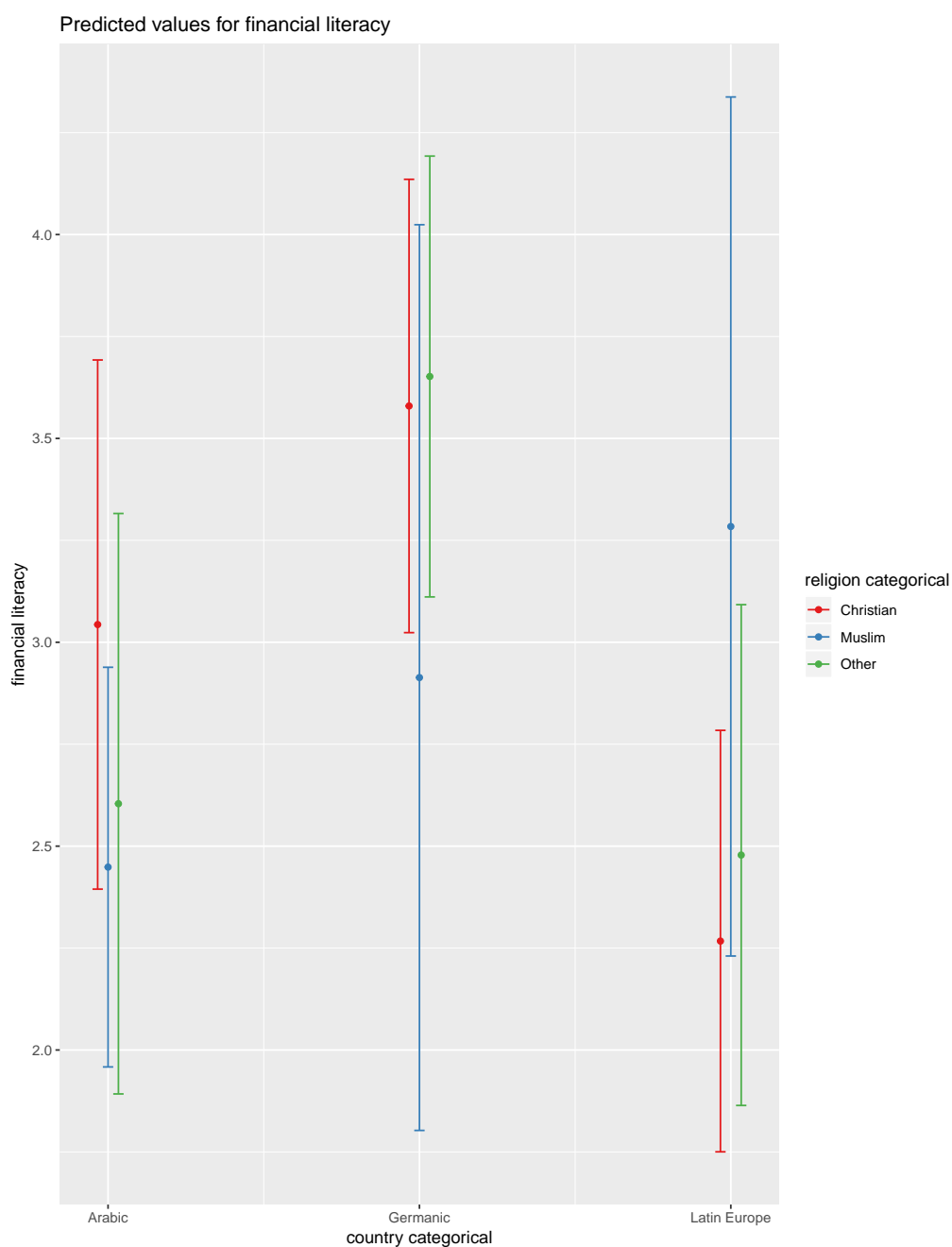


Figure 3.5: Interaction margins plot between religion and geographic regions

In contrast with our regression results using our first proxy of financial literacy, financial socialization is positive and significant in the IV regression and GMM. In the GMM result, an increase in one standard deviation of financial socialization by parents raises cumulative financial literacy by 0.45 standard deviations. This result is significant and it complies with the previous empirical findings.

Concerning our cultural variables, our proxy for family ties is positive and statistically non-significant in the OLS results. The IV the GMM results show a negative and statistically non-significant coefficient of our proxy for family ties. In the GMM, an increase in one standard deviation lowers cumulative financial literacy by 0.08 standard deviations and the result is statistically non-significant. Moreover, religiosity is negative and statistically non-significant in the OLS, IV regression and GMM models. In the GMM, an increase in one standard deviation in religiosity lowers the cumulative financial literacy by 0.04 standard deviations.

Our psychological variables show similar results when we apply our second proxy of financial literacy. The effect of impatience is significant in the OLS regression but statistically non-significant in the IV regression and GMM in table 3.5. In the GMM, an increase in one standard deviation in impatience lowers financial literacy by 0.04 standard deviations and the result is statistically non-significant. Moreover, the effect of confidence remains positive and significant in the OLS and IV regression, but becomes statistically non-significant in the GMM in column 4 of table 3.5. In the IV regression, an increase of one standard deviation in confidence raises financial literacy by 0.25 standard deviations and the result is significant. In the GMM, an increase in one standard deviation in confidence raises cumulative financial literacy by 0.13 standard deviations.

Germanic countries continue to have higher financial literacy scores compared with Arabic and Latin European countries. Also, Muslim respondents perform worse than the Christian and "other" religion categories. Additionally, males have a higher command of financial literacy compared to females.

We also perform robustness checks by applying the same regression model using our second proxy of financial literacy, after we remove one of the geographic regions one at a time. The results are similar to our findings in in columns 1, 2 and 3 in table 3.5.

In conclusion, we find that numeracy, math skills at 10, financial socialization by parents and confidence have a positive effect on financial literacy. On the other hand, family ties and impatience negatively affect financial literacy. Religiosity has an statistically non-significant effect in both models 3.3.1 and 3.3.2. Individuals from Germanic countries perform better than the other two geographic regions and Muslims have had less in financial literacy scores compared

to non-Muslims. Moreover, males tend to have a higher financial literacy than females. As we can see, the results are consistent over models 3.3.1 and 3.3.2.

In the next section, we apply Principal Component Analysis and Principal Component Regressions. Because these models are suitable for multidimensional data, we do not aggregate our independent variables. Instead, we consider every question that measures our independent variables as a unique independent variable in the PCA.

3.5.2 Results for PCA and PCR

Due to the high dimensionality of the independent variables, we run Principal Component Analysis and Principal Component Regression to our sample. Before conducting our PCA and PCR, we check for internal consistency of all our survey questions using Cronbach alpha test. All the variables have a standardized alpha between 0.59 and 0.66, which shows an internal consistency in the survey questions. Instead of constructing scores for every independent variable, we use every question in our PCA model. When we apply PCA while using financial literacy scores as the dependent variable, we find that the error rate drastically falls at the 8th component and the results show that 8 components explain 75% of the model. To verify our choice of using 8 components, we conduct a parallel analysis which predicts the number of components that are needed to explain the model. Parallel analysis, presented in figure 3.6 also suggests using 8 principal components.

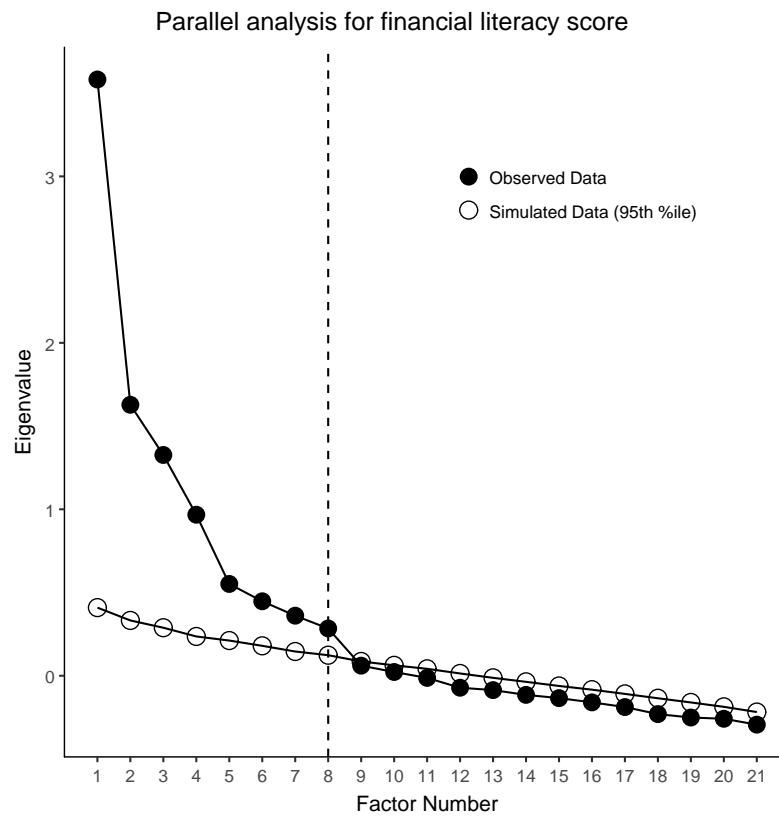


Figure 3.6: Parallel analysis scree plot for financial literacy

After choosing the number of components needed, we run a principal component regression. The regression uses the 8 components as independent variables that extracts the coefficients for every question in our survey. This analysis is limited to the continuous variables in the sample. The results that are presented in table 3.7 show that, on aggregate, financial socialization, religiosity, family ties, impatience and age negatively affect the financial literacy score. In addition, numeracy scores and confidence are positively associated with financial literacy score. We also run PCA and PCR using cumulative financial literacy as dependent variables. The results are consistent with our previous PCA and PCR. The results are also presented in table 3.7.

Table 3.7: Principal Component Regression coefficients using 2 proxies of financial literacy as dependent variables

Independent Variable	Financial Literacy (8 components)	Cumulative Financial Literacy (7 components)
financial socialization_1	-0.045	0.050
financial socialization_2	-0.043	0.061
religiosity_1	-0.096	-0.076
religiosity_2	-0.104	-0.130
confidence_1	0.086	0.150
confidence_2	0.006	0.074
confidence_3	-0.021	0.033
confidence_4	0.016	0.083
confidence_5	-0.008	0.030
impatience_1	-0.010	-0.090
impatience_2	-0.070	-0.090
impatience_3	0.036	-0.004
impatience_4	-0.128	-0.200
family ties_1	0.023	-0.127
family ties_2	-0.010	-0.081
family ties_3	-0.083	-0.138
numeracy	0.291	-
math at 10	0.249	0.187
age	-0.210	-0.299

Note: We perform Principal Component Regressions using 8 principal components as suggested by our parallel analysis. We also perform PCR using our second proxy for financial literacy which entangles numeracy using 7 principal components and the results are consistent with our findings

Table 3.8: Summary of the regression results

Independent Variable	Financial Literacy	Cumulative Financial Literacy
numeracy	+	0
financial socialization	+	+*
family ties	-***	-*
religiosity	+	-
impatience	-	-
confidence	+***	+*
age	x	+
math at 10	0	+***

Note: + is for positively correlated, - is for negatively correlated, x is for uncorrelated, 0 is for not being included in the regression, * is for statistically significant at 10%, ** is statistically significant at 5% and *** is for statistically significant at 1%.

3.5.3 Artificial Intelligence

The use of prediction models and machine learning are becoming more popular in finance studies due to their ability to predict important decision variables. Using Regression Trees and Random Forest analysis are advantageous due to their ability to rank the determinants of financial literacy by importance. We run three machine learning algorithms and base our results on the algorithm with the lowest root mean square error.

In this section, we present the results of Regression Trees, Random Forest and Quantile Regression Forests algorithms. Our first Regression Trees analysis uses financial literacy score as the dependent variable. The Regression Trees results are presented in table 3.9. The Regression Trees result shows that the most important predictor of a financial literacy score is the geographic region. Financial literacy score varies most widely between respondents from Germanic, Latin European and Arabic speaking countries, followed by household income and numeracy as the important predictors of financial literacy levels. Other main predictors of financial literacy are financial socialization, family ties, religiosity, age, impatience and confidence.

Table 3.9: Summary of the three machine learning algorithms that show the rank of the independent variables by importance in affecting our 2 proxies of financial literacy

Rank	Financial Literacy			Cumulative Financial Literacy		
	Random Forest	Regression Trees	Quantile Regression Forests	Random Forest	Regression Trees	Quantile Regression Forests
1	geographic region	geographic region	geographic region	geographic region	geographic region	geographic region
2	numeracy	household income	numeracy	religion	impatience	math at 10
3	household income	numeracy	household income	math at 10	math at 10	religion
4	religion	financial socialization	age	religiosity	confidence	confidence
5	gender	family ties	religiosity	confidence	education	household income
6	financial socialization	religiosity	religion	household income	age	impatience
7	business/economics at university	age	financial socialization	impatience	financial socialization	family ties
8	confidence	impatience	impatience	gender	family ties	education
9	age	confidence	education	education	household income	religiosity
10	religiosity	religion	family ties	business/economics at university	business/economics at university	age
11	education	education	confidence	age	religiosity	financial socialization
12	family ties	business/economics at university	gender	family ties	religion	business/economics at University
MSE	1.23	1.27	2.38	1.82	2.65	4.77

We also run Regression Trees using cumulative financial literacy score as the dependent variable. This proxy integrates numeracy as a part of the financial literacy score. The Regression Trees results is available in table 3.9.

When we introduce numeracy scores as a part of the respondent's financial literacy, the geographic region remains the most important predictor of cumulative financial literacy. Impatience, math skills at age of 10, confidence, education, age, financial socialization and family ties are next in importance. The results are presented in table 3.9.

After we test the accuracy of the two Regression Trees models, the mean squared error of the financial literacy score model is 1.23 and the mean squared error of the cumulative financial literacy model is 1.82. However, our first Regression Trees model has an R Squared of 44% compared to an R Squared of 28% in the second model.

With the first Regression Trees model providing less error and almost similar predictability, we base our conclusion based on column 2 in table 3.9 and find that the most important predictors of financial literacy by rank are geographic region, numeracy, household income, religion, gender, financial socialization, studied business/economics at university, confidence, age, religiosity and education.

Random Forest analysis is a solution for reducing the variance of the Regression Trees model. With Random Forests, the idea is to lower the correlation of many trees which are generated on the different bootstrapped samples from training data. The variance is reduced by averaging the generated sample trees.

Table 3.10: Random Forest results for financial literacy score by independent variable importance

Independent variable	Inc.MSE
geographic region	0.395
numeracy	0.194
household income	0.094
religion	0.063
gender	0.062
financial socialization	0.044
business/economics at university	0.037
confidence	0.035
age	0.034
religiosity	0.033
education	0.019
family ties	0.011
impatience	0.007
marital status	0.003

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the minimum number of splits is 4. The number of trees is 500. The R squared for this Random Forest is 26.39% and the mean squared error is 1.23. The predictability shows an R squared of 44%. Averaging the trees helps reduce the variance and improve the performance of Regression Trees on the test set and, eventually, avoid over fitting. The idea is to build lots of trees so as to make the correlation between the trees smaller.

After we prune our Random Forest model, we run a Random Forest model with 500 trees and 4 variables for splitting each tree node using financial literacy score as the dependent variable. The Random Forest method is the unconditional mean decrease in accuracy using Breiman method. The first model uses financial literacy score as dependent variable. The model explains 26.39% of the variance, which is a moderate predictability level for this kind of sample. The mean squared error is 1.23. Table 3.10, presents the accuracy scores of the independent variables by importance.

Table 3.11: Random Forest results for cumulative financial literacy score by independent variable importance

Independent variable	Inc.MSE
geographic region	0.881
religion	0.326
math at 10	0.321
religiosity	0.126
confidence	0.107
household income	0.094
impatience	0.091
gender	0.086
education	0.069
business/economics at university	0.062
age	0.024
family ties	0.022
financial socialization	0.019
marital status	0.014

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. The minimum number of splits is 4. The number of trees is 500. The R squared for this Random Forest is 25.8% and the mean squared error is 1.82. The predictability shows an R squared of 28%.

As shown, in the Random Forest analysis presented in table 3.10, the geographic region is the top predictor of financial literacy. Moreover, numeracy, household income, religion, gender, financial socialization, religion, business and economic studies at the university, religiosity, confidence and age are the next predictors of financial literacy. The accuracy of the model is 43.6%, which is very good for this kind of sample. In this Random Forest analysis, we find no strong effect of family ties on financial literacy, however, religion, religiosity and confidence are important predictors of financial literacy.

We also run a Random Forest analysis using cumulative financial literacy as a dependent variable. The rank of independent variables by importance is in table 3.11. The model explains 25.8% of the variance and the mean squared error is 1.82. The accuracy of the predictability of the model is 28%, which is lower than the previous Random Forest model. The results by importance of the independent variable are similar to the previous Random Forest model. The accuracy of the Random Forest model is lower than the results from the Regression Trees analysis, which is attributed to the small sample size used in our Random Forest models. We base our conclusion on the first Random Forest model presented in table 3.10 because it has a lower mean squared error. We find that the most important predictors of financial literacy in the Random Forest model are geographic region, numeracy, household income, religion, gender, financial socialization, business/economics studies at the university, religiosity and confidence. Demographics, numeracy and financial socialization by parents are the main predictors of financial literacy which is consistent with the findings in the literature. However, we present new evidence which finds that religiosity and confidence are also important determinants

of financial literacy.

In addition to the Unconditional Random Forest Breiman approach, we apply Quantile Regression Forests. This approach offers a non-parametric approach of estimating conditional quantiles of predictor variables. Our quantiles are 5%,25%,50%,75% and 95%. The results of our first Quantile Regression Forests with financial literacy as the dependent variable show that the main drivers of financial literacy are geographic region, numeracy, household income, age, religiosity, religion, financial socialization, impatience, education and family ties. The model accuracy is 83.73% and the mean squared error is 2.3868.

Using cumulative financial literacy, the Quantile Regression Forests show that the top predictors are geographic region, math at 10, religion, confidence, household income, impatience, family ties, education and religiosity. The accuracy is 85.08% and the mean squared error is 4.774. The results of our Quantile Regression Forests are available in columns 3 and 6 of table3.9.

In conclusion, we base our results on the model with the lowest mean squared error. The Random Forest has the lowest mean squared error at 1.23. According to the Random Forest model, the main predictors of financial literacy are geographic region, numeracy, household income, religion, gender, financial socialization by parents, business/economics studies at the university, religiosity and confidence. The results are consistent across the selected three machine learning algorithms. In comparison with the regression models, PCA and PCR, our machine learning algorithms provide similar results, which adds robustness to our study. However, Random Forests show that family ties are not among the major important drivers of financial literacy. In compliance with the previous financial literacy studies, the main drivers of financial literacy are numeracy, financial socialization by parents and demographic variables. However, our findings show that geographic region, religion, religiosity and confidence also have an influence on financial literacy. The next section concludes.

Table 3.12: Summary of the Random Forest rank of independent variables by importance in affecting financial literacy and cumulative financial literacy

Rank	Financial Literacy	Cumulative Financial Literacy
1	geographic Region	geographic Region
2	numeracy	religion
3	household income	math at 10
4	religion	religiosity
5	gender	confidence
6	financial socialization	household income
7	business/economics at University	impatience
8	confidence	gender
9	age	education
10	religiosity	business/economics at university
11	education	age
12	family ties	family ties
MSE	1.23	1.82

We also run the machine learning algorithms after we exclude the geographic region variable from the sample. The results are similar to the previous results but have a higher root mean-square error, and can be found in table 3.13.

Table 3.13: Summary of the rank of independent variables by importance without the geographic region variable, in affecting financial literacy and cumulative financial literacy

Rank	Financial Literacy	Cumulative Financial Literacy
1	numeracy	religion
2	household income	math at 10
3	religion	household income
4	religiosity	religiosity
5	age	gender
6	financial socialization	confidence
7	gender	business/economics at University
8	business/economics at University	impatience
9	confidence	education
10	family ties	family ties
11	education	financial socialization
12	impatience	age
MSE	1.32	3.48

3.6 Conclusion and Recommendations

In previous papers, investing in financial literacy is considered as a choice for individuals to improve their financial behavior. However, there is a lack of research on what determines financial literacy among individuals. In this paper, we consider demographic, socioeconomic, psychological and cultural factors as determinants of financial literacy. Our contribution lies in the comparative aspect of our sample selection in which we select Germanic, Arabic and Latin European sub samples to compare the determinants of financial literacy across different regions. Addressing the issue of measurement error associated with previous financial literacy studies, we select two proxies of financial literacy in which one proxy integrates numeracy as a part of financial literacy and the other does not. We also control for omitted variable bias by introducing psychological (confidence and impatience) and cultural factors (family ties and religiosity) as determinants of financial literacy. Moreover, we introduce AI using machine learning algorithms for the first time in a financial literacy study. Applying Regression Trees, Random Forests and Quantile Regression Forests can be advantageous for cross-financial literacy studies due to their ability to predict the determinants of financial literacy and rank them by importance.

We validate our empirical model with micro-economic data. We use a cross-region survey collected across Arabic, Germanic and Latin European countries. Our dependent variable is financial literacy and our independent variables are numeracy, math skills at 10, financial socialization by parents, confidence, impatience, family ties, religiosity and a vector of demographics.

We apply OLS regressions with fixed effects, IV regressions, GMM, PCA and PCR. To control for endogeneity of numeracy, we use instrumental variable regression using need for cognition, parental education and language proficiency as instruments. Our regression analysis finds that numeracy, financial socialization, math skills at the age of 10, confidence, Germanic countries, males and Christians have a positive influence on financial literacy. In addition, family ties and impatience have a negative influence on financial literacy. Religiosity has a weak and statistically non-significant effect on financial literacy.

We also apply AI techniques for the first time in financial literacy studies. The applied algorithms consist of Regression Trees and Random Forest analysis. The advantage of using these techniques is that they allow us to predict the

most important variables that describe financial literacy.

The results show that financial literacy is positively associated with numeracy, financial socialization by parents, confidence and geographic location, In addition, financial literacy is negatively associated with impatience and family ties. The results also show that financial literacy is mainly described by geographic region, numeracy, household income, religion, gender and financial socialization.

The results can be used to adjust the design and improve the implementation of financial education programs based on people's culture and habits. If numeracy remains the most influential determinant of financial literacy, governments can strengthen their math courses in their educational curricula. Also, if financial socialization is an important determinant of financial literacy, financial education programs can be catered to parents highlighting the importance of passing financial knowledge to their children. Moreover, in countries with strong family ties, governments may wish to invest in financial education programs for parents, which will ultimately improve the financial literacy and financial behavior of their children. Moreover, in religious countries, financial education program can be integrated in places of worship by educating religious leaders, which will in turn target religious people. In addition, financial education programs can target specific individuals such people who are impatient and lack confidence. The best way to address the impatient and the in-confident is by tracking their financial behavior after they finish their financial education courses, where this can help such individuals learn by example. We recommend more experimental studies that can test different approaches to constructing financial education programs that can be effective in improving financial behavior across different cultures and traditions around the world.

CHAPTER 4

Numeracy, psychological traits, cultural factors and financial socialization: Are they determinants of financial behavior?

Abstract

We present a comparative cross-region study that explains individual financial behavior level through financial literacy, financial socialization by parents, numeracy, demographic, psychological factors (impatience, risk-taking and confidence) and cultural factors (family ties and religiosity). We use five proxies of financial behavior: active saving, budgeting, punctual debt payment, stock market participation and retirement saving. We introduce cultural factors (family ties and religiosity) for the first time in a financial literacy study to control for omitted variable bias. This study addresses the need for a model that identifies the financial behavior level across financial literacy, financial socialization, numeracy, demographic, psychological and cultural variables, and help to identify the determinants to improve financial behavior in an effective manner. The main variables of interest are financial literacy, numeracy, financial socialization by parents, religiosity, family ties, confidence, impatience and geographic region. We produce a query that aggregates all these factors and is applied to 600 individuals from Arabic countries (300 responses), Germanic countries (149 responses) and Latin European countries (151 responses). The data is analyzed using OLS regression with country fixed effects, IV regression, GMM, PCA and PCR. Moreover, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. AI techniques that are introduced to provide a predictive approach of financial behavior determinants. We find that financial behavior is mostly determined by financial socialization by parents, impatience, confidence, risk-taking, financial literacy, numeracy, family ties and religiosity. We find that the main predictors of active saving are impatience, financial socialization, confidence, gender, religiosity, geographic region, family ties, age, religion, risk-taking, household income, education, financial literacy, studied business/economics at university, marital status and numeracy. We also find that the main drivers of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business/economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status. The main pre-

dictors of punctual debt payment are family ties, financial socialization, confidence, household income, financial literacy, impatience, religion, risk-taking, numeracy, geographic region, religiosity, age, education, studied business/economics at university, gender and marital status. The most important drivers of stock market participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business/economics at university and financial socialization. Finally, the most important drivers of retirement saving are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity. Individuals with strong family ties and religiosity may rely on other sources for retirement savings such as inheritance. Our findings show that financial literacy is not always the main determinant of financial behavior. The effect of numeracy, financial socialization, family ties, religiosity, impatience, confidence on financial behavior suggest that relying solely on financial literacy is not a solution to improve individual financial behavior. These findings suggest that new ways to improve financial behavior could be explored. This can be done using financial education programs that integrate psychological and cultural differences. In addition, the inability of financial education programs to consistently improve financial behavior may result in new public policies that help individuals attain financial well-being.

Index terms— Financial Literacy, Financial Behavior, Psychological traits, Culture

4.1 Introduction

Individuals are becoming increasingly active in financial markets, and market participation is being accompanied or even promoted by the advent of new financial products and services. However, some of these products are complex and difficult to grasp, especially for financially unsophisticated investors. At the same time, market liberalization and structural reforms to social security and pensions cause an ongoing shift in decision-making responsibility away from the government and employers and toward private individuals. Thus, individuals have to assume more responsibility for their own financial well-being (Van Rooij et al., 2011b).

There is a little research on whether individuals possess adequate financial literacy to make financial decisions and few existing studies focus on the importance of financial literacy as a determinant of financial behavior (Lusardi and Mitchell, 2014a; Howlett et al., 2008; Gathergood and Weber, 2014). Researchers suggest that improving financial

literacy through financial education programs are the assumed remedy for the financial challenges that individuals face. According to Willis (2011) and Lusardi and Mitchell (2014a), financial literacy is positively associated with improving financial behavior. However, according to Hastings et al. (2013), Hira (2010), Adams and Rau (2011) and Fernandes et al. (2014), increasing financial literacy levels has a weak effect on an individual's financial behavior.

Researchers face the challenge of finding out if financial literacy does indeed have an important impact on financial behavior, though the effect of financial literacy on financial behavior is difficult to measure due to endogeneity. Endogeneity is driven by three main factors which are omitted variable bias, reverse causality and measurement error. In our study, we address the problem of endogeneity by controlling for these three drivers of financial literacy endogeneity.

To control for omitted variable bias, which comes from the lack of finding proper variables other than financial literacy that influence financial behavior, we introduce cultural factors proxies which are family ties and religiosity. Previous studies suggest that family ties and religiosity have a significant effect on individual's economic attitudes (Renneboog and Spaenjers, 2012; Guiso et al., 2003; Alesina and Giuliano, 2014). Yet, no previous financial literacy study considers religiosity and family ties as determinants of financial behavior. Based on this rationale, we contribute to the previous empirical work on financial literacy by including family ties and religiosity as determinants of financial behavior.

To address the reverse causality problem of financial literacy which is due to possibility of financial literacy affecting financial behavior and vice versa, we run instrumental variable regressions in a cross regional study that includes three regions which are Germanic, Latin European and Arabic regions. Researchers find financial literacy endogenous because they still do not know whether it is a tool for improving financial behavior or just an outcome of individual experience with financial behavior. To control for this problem, researchers rely on instrumental variables. Instrumental variables should have a direct effect on financial literacy and an indirect effect on financial behavior, and using instrumental variables can show if financial literacy is a determinant of financial behavior. The instruments we use to address the endogeneity of financial literacy are the "need for cognition" (Fernandes et al., 2014), mother's education (Behrman, Mitchell, Soo and Brava, 2012), language proficiency and math skills at the age of 10 (Jappelli and Padula, 2013). These instruments are considered valid due to their direct effect on financial literacy and indirect effect on financial behavior. Even though instrumental variables are easily destroyed, they are still a good tool to control for endogeneity of financial literacy.

The third endogeneity challenge in financial literacy studies is associated with the measurement error of financial literacy that lies in the difficulty of constructing a robust operational definition of financial literacy that serves as a good proxy measure of individual financial literacy. We also contribute to the empirical work on financial literacy by using two different proxies to measure financial literacy.

The reason for using two measures of financial literacy is the ongoing debate on the importance of numeracy as being both a strong determinant of financial literacy and also a strong determinant of financial behavior (Almenberg and Widmark, 2011; Banks, 2010; Estrada-Mejia et al., 2016). From this perspective, we control for the differences between numeracy as being both a part of financial literacy measurement and as a determinant of financial literacy. That is, our first proxy measure of financial literacy uses four questions about inflation, diversification and interest rates (Kadoya and Khan, 2016; Lusardi and Mitchell, 2011c). On the other hand, the second proxy measure of financial literacy combines three numeracy questions with the four previous questions (Klapper et al., 2015). In our study, we operationally define financial literacy in two ways. Our first definition of financial literacy is the ability to understand the implications of interest, inflation and diversification. The second definition is the ability to understand the implications of numeracy, interest, inflation and diversification.

We construct and apply a survey on financial literacy across nine countries (Lebanon, Syria, Jordan, Egypt, UAE, Germany, Holland, Portugal and Spain). By covering three different regions: Arabic region (Lebanon, Syria, Jordan, Egypt, UAE), Germanic region (Germany and Holland) and Latin Europe (Portugal and Spain), we collect data from different cultural values; native languages, religiosity and family values and ties. The Arabic region (1) hosts the birth of monotheistic religions: Judaism, Christianity and Islam (2) has strong family ties according to the World Values Survey (WVS) and (3) includes Arabic speaking countries. The Germanic region (Germany and Holland) (1) is the main contributor to the rise of Protestantism, (2) has distinctive cultural values and according to the World Value Survey (WVS), has weak family ties and (3) the native language is Germanic. Finally, the Latin region covers Portugal and Spain that (1) have a Catholic background, (2) stronger family ties, according to the World Values Survey, and (3) are Latin-speaking countries. These three regions provide a proper sample to control the main variables interest.

In addition to using samples from three different regions in finding the determinants of financial behavior, we also analyze our data by using sub-samples that eliminate one of the selected regions one at a time. That is, we analyze the

whole sample after eliminating the Arabic region, then we analyze the whole sample after eliminating the Latin European region and finally analyze the whole sample without the Germanic region. This approach is used to add robustness to our results.

Before analyzing the data, we apply propensity score matching which eliminates the observations that are not homogeneous across the sample. In addition, we eliminate the observations that do not belong to our three regions, which reduces our responses to 600. The survey includes close-end Likert scale questions related to demographics, financial socialization by parents, financial literacy, numeracy, cultural (family ties and religiosity) and psychological traits (confidence, risk-taking and impatience).

Our dependent variable is financial behavior (five proxy measures which are active saving, budgeting, punctual debt payment, stock market participation and retirement saving) and our independent variables are financial literacy (two proxies), financial socialization by parents, numeracy, religiosity, family ties, confidence, impatience, risk-taking and a vector of demographics.

We apply OLS regressions using country fixed effects, IV regressions and Generalized method of Momentum, Principal Component Analysis and Principal Component Regression to analyze the data. We use instrumental variables such as mother's education (Behrman, Mitchell, Soo and Brava, 2012), need for cognition (Fernandes et al., 2014) and math skills at 10 (Jappelli and Padula, 2013) as a tool to control for the endogeneity problem of financial literacy.

Moreover, we apply Artificial Intelligence using machine learning algorithms which use Regression Trees, conditional Random Forests and Quantile Regression Forests to add robustness to the regression models and to predict the most important independent variables in explaining financial behavior.

Our contribution to financial literacy studies takes different forms. Firstly, we introduce new variables as suggested determinants of financial behavior, which are religiosity and family ties. Introducing these two variables serve as an attempt to control for the omitted variable bias that is previously witnessed in financial literacy studies. Secondly, we use two proxy measures of financial literacy to combine/separate numeracy from financial literacy. Using two proxies of financial literacy serves as an attempt to control for the measurement error of financial literacy. Thirdly, our sample

selection is unique and is based on cultural differences such as family ties, religiosity levels and language diversity. Finally, our major contribution to financial literacy studies is the application of Artificial Intelligence techniques to support our regression and Principal Component Analysis. The advantage of using AI algorithms lies in their ability to predict the determinants of financial behavior and rank them by importance.

In addition, our research suggests that relying solely on financial literacy is not a solution for improving financial behavior. The effect of financial socialization, numeracy, family ties, religiosity, confidence, impatience and risk-taking on financial behavior is present in our findings, and, based on that, we suggest that financial education programs integrate cultural and psychological factors in their implementation to improve individual financial behavior.

We find that the main predictors of active saving are impatience, financial socialization, confidence, gender, religiosity, geographic region, family ties, age, religion, risk-taking, household income, education, financial literacy, studied business/economics at university, marital status and numeracy. We also find that the main drivers of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business/economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status.

The main predictors of punctual debt payment are family ties, financial socialization, confidence, household income, financial literacy, impatience, religion, risk-taking, numeracy, geographic region, religiosity, age, education, studied business/economics at university, gender and marital status. The most important drivers of stock market participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business/economics at university and financial socialization.

Finally, the most important drivers of retirement saving are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity. Individuals with family ties and religiosity may rely on other sources for retirement savings such as inheritance.

The results are consistent across the different techniques used and show that our financial behavior proxies are determined by financial socialization by parents, cultural factors, psychological traits, financial literacy, numeracy and demographics. We find that financial literacy, financial socialization by parents and numeracy are not always main determinants of financial behavior. Our findings show evidence of psychological traits and cultural factors also having an influence on individuals' financial decisions. These findings uncover the need for different implementation of financial education programs to effectively improve financial behavior. Based on our findings, we suggest that financial education programs can be implemented based on cultural differences, specifically family ties, religion and religiosity. In communities with strong family ties and religiosity, parents and religious figures will have a greater influence on individuals. From this perspective, targeting financial education programs to parents and religious figures can be a way to strengthen financial literacy and improve financial behavior to target audiences. Moreover, the difficulty to control for psychological differences to improve financial behavior may suggest the need for protective policies and need to invest in improving the financial well-being of individuals.

The rest of the paper is organized as follows. Section 2 presents the current relevant literature on financial literacy, numeracy, cultural factors and psychological traits. Section 3 describes the methodology selected. Section 4 presents the econometric estimates and machine learning algorithms selected, using microeconomic data. Section 5 concludes.

4.2 Literature Review

In this section, we present the ongoing literature on financial literacy and its endogeneity problem, numeracy, financial socialization by parents, financial behavior; and, our choice of cultural, psychological and demographic variables to include in our study.

4.2.1 Financial Literacy and Financial Behavior

In this paper, we aim to uncover if financial literacy has a consistent positive effect on financial behavior. In previous studies, financial literacy is associated with better retirement planning (Lusardi and Mitchell, 2007*b*; Van Rooij et al., 2011*b*). In analyzing German data Bucher-Koenen and Lusardi (2011) also find evidence of a positive effect of financial literacy on retirement planning. Also, in studies that analyze financial behavior, Lusardi and Mitchell (2007*b*) and Lusardi and Mitchell (2011*b*) find that individuals with low levels of financial literacy are less likely to plan for retirement.

In addition to retirement planning, other financial behavior proxies previously studied are saving decisions, budgeting and planning. In global studies, Lusardi and Mitchell (2011c) and Behrman, Mitchell, Soo and Bravo (2012) find that financially literate individuals make better saving decisions which implies evidence that financially literate individuals have the ability to budget and plan ahead. In a Dutch study, Deuffhard et al. (2014) find that individuals with higher financial literacy levels have higher returns on their savings accounts. In addition, Hilgert et al. (2003) find a strong correlation between higher levels of financial literacy and budgeting and managing day-to-day financial tasks.

A positive correlation between financial literacy and stock market participation has been observed by (van Rooij et al., 2011a; Van Rooij et al., 2011b; Christelis et al., 2010; Clark et al., 2017). In a Dutch study, Van Rooij et al. (2011b) find that retail investors with higher financial literacy have a higher rate of participation in the stock market.

Also, the effect of financial literacy on debt behavior is presented in the literature. Lusardi and Tufano (2015) and Gathergood and Weber (2014), in US and UK studies, find that individuals with higher levels of financial literacy are less likely to accumulate debt or default on debt. Moreover, the authors find that individuals with low financial literacy are not aware of their debt positions. Lusardi and Tufano (2015) also find that individuals with low levels of financial literacy are more likely to have inefficient credit card behavior.

In our study, we find the effect of financial literacy and other independent variables such as financial socialization by parents, numeracy, cultural factors and psychological traits on five proxies of financial behavior. Our five proxies of financial behavior are individual active saving, budgeting and planning of revenues of expenses, retirement saving, punctual debt payment and stock market participation.

4.2.2 Endogeneity and Financial Literacy

Empirical studies show a positive correlation between financial literacy measures and improved financial behavior. However, without sufficient truly randomized control experiments that allow direct causality, the effect of financial literacy on financial behavior is difficult to determine. As most financial literacy studies dealing with the effect of financial literacy on financial behavior are non-experimental, endogeneity presents a challenge which should be considered carefully. Hastings et al. (2013) find that while endogeneity does not rule out the possibility of a positive effect of financial literacy

on financial behavior, it complicates the interpretation of coefficients of the estimated effects as they can be upward biased.

Omitted variable bias is one of the main sources of endogeneity and stands for the independent variables that should be included in a regression models but are not. The literature attempts at finding some hard to capture variables that can influence financial behavior. In controlling for omitted variable bias, Gudmunson and Danes (2011) and Grohmann et al. (2015) introduce financial socialization in a financial literacy study and find that financial socialization by parents positively influences financial behavior. Also, Estrada-Mejia et al. (2016) find that numeracy is a determinant of financial behavior where individuals with high numeracy skills have better financial decisions. Meier and Sprenger (2010) add psychological variables such as the discount factor to control for the omitted variable bias in financial literacy studies and finds that individuals with low impatience levels and high discount factors are more likely to invest in stock markets. In addition, Hastings and Mitchell (2011) find that impatient individuals are less likely to additionally save for retirement in comparison with patient individuals. In addition to the discount factor, Fernandes et al. (2014) include risk-taking and confidence as psychological determinants of financial behavior. The authors find that these psychological variables are stronger drivers than financial literacy in determining financial behavior. To control for omitted variable bias we present new independent variables in our study, which are family ties and religiosity. To date, these variables have not been used in previous financial literacy and financial behavior studies.

Another main source of endogeneity is the measurement error in financial literacy measurement. The most commonly used way to measure financial literacy in the literature is the "big three" score suggested by (Lusardi and Mitchell, 2009). In this study, the authors measure financial literacy using three questions related to portfolio diversification, interest rates and inflation.

To have a more specific operational definition that helps us better measure financial literacy, we define financial literacy as the knowledge of an individual about numeracy, interest compounding, inflation and risk diversification. In addition, we redefine financial literacy independent from numeracy as the knowledge of an individual about interest compounding, inflation and risk diversification. Applying these definitions make financial literacy a unidimensional variable that is easy to measure.

To control for the measurement error problem, we use two measurement proxies of financial literacy. The first proxy is the classic "big three" which measures financial literacy using questions about inflation, interest rates and diversification. Our second measurement proxy measure combines three numeracy questions with the classic "big three". We run regressions using both measures of financial literacy to control for this measurement error of financial literacy.

Another driver of endogeneity is the reverse causality problem. The fact that financial literacy can influence financial behavior and, vice versa fuels the ongoing debate on whether financial literacy can truly influence financial behavior. We control for this problem using instrumental variables. To approach the endogeneity problem, a standard approach is finding an instrumental variable for the endogenous independent variable, which is, in this case, financial literacy. To control for endogeneity of financial literacy in its effect on financial behavior, need for cognition is used as an instrumental variable by (Fernandes et al., 2014; Estrada-Mejia et al., 2016). According to Epstein et al. (1996), the need for cognition is a good instrument for financial literacy because this instrument is not plausibly caused by financial behavior. The need for cognition is the individual tendency to engage in deliberate thoughts to ignore irrelevant information and evaluate ideas. The need for cognition is exogenous and, thus, a suitable instrument for financial literacy (Fernandes et al., 2014).

Another instrument used to test for endogeneity of financial literacy is the savings amount of the eldest sibling in the family (Van Rooij et al., 2011*b*; Deuflhard et al., 2014). This instrument is directly correlated with financial literacy and not directly related to the individual's financial wellness. Other instruments applied to solve for the endogeneity of financial literacy are economics education of individuals (Deuflhard et al., 2014; Lusardi and Mitchell, 2011*b*) and intelligence (Estrada-Mejia et al., 2016). In addition, Behrman, Mitchell, Soo and Bravo (2012) use three instrumental values to treat the causality and omitted variables that explain financial literacy. The study aims at finding the effects of financial literacy and schooling on wealth accumulation. The candidate instruments that are used are age-related factors such as government policies and macroeconomic conditions at the time of school, family background and personality traits (risk aversion, self-esteem). Also, Jappelli and Padula (2013) use math skills at the age of 10 in the SHARE WAVE data study as an instrument for financial literacy. This instrument is valid because it is directly correlated with financial literacy and indirectly correlated with financial behavior measures.

In our study, we also address the endogeneity problem of financial literacy by using instrumental variables. Our selected instruments are need for cognition, math skills at the age of 10, language proficiency and mother's education.

These instruments are suitable for financial literacy studies as previously presented in the literature.

4.2.3 Numeracy, Demographics and Financial Socialization by Parents

In the current literature on financial literacy and its effect on financial behavior, many authors study the effect of numeracy on individual financial outcomes. Numeracy, which is defined as the ability to understand and use numerical information, is associated with an increase in personal wealth (Estrada-Mejia et al., 2016) (Banks et al., 2011) and associated with house and stock market ownership (Almenberg and Widmark, 2011).

An ongoing debate about separating financial literacy from concepts like numeracy and cognitive abilities is evident in the literature. In fact, a tight link between numeracy and financial literacy is evident in two of the three pioneering standard questions used to measure financial literacy (Lusardi and Mitchell, 2011c). Yet, numeracy is shown as a stronger factor than financial literacy in explaining financial wellness (Almenberg and Widmark, 2011). This empirical evidence creates confusion when numeracy serves to be both, a determinant of financial literacy, and a proxy for financial literacy in determining financial behavior. In our study, we use numeracy as both a determinant of financial behavior and a part of the measurement proxy of financial literacy.

Researchers try to identify which demographic groups such as country, gender, ethnicity, occupation have better financial behavior. Concerning demographics, gender gaps in financial behavior are empirically evident. Financial behavior is worse for females, with less stock market participation, less wealth accumulation and higher indebtedness (Lusardi and Mitchell, 2011c; Van Rooij et al., 2011b; Bucher-Koenen et al., 2017; Lusardi and Tufano, 2015). Age also explains the financial behavior gaps between individuals. According to Lachance and Choquette-Bernier (2004), people tend to learn from their mistakes and eventually learn more over time. That is, the higher the age, the better the financial behavior.

Education level of the individual and spouse also explain the gaps in financial behavior among individuals (Grohmann et al., 2015; Lusardi and Mitchell, 2011b,c). Moreover, behavioral economic theories that are in favor of cognitive abilities empirically show the positive impact of education on financial wellness (Gill and Prowse, 2016; Lusardi et al., 2010). Also, according to social learning theories, the education level of an individual's spouse or parent also has an effect

on financial wellness. Empirically, parents' education level influences their improves their children's financial behavior (Mahdavi and Horton, 2014). In addition, financial socialization by parents and business/economics education at the university lead to a better financial behavior among individuals (Grohmann et al., 2015; Mahdavi and Horton, 2014; Almenberg and Widmark, 2011).

In this study, we find the effect of numeracy, financial socialization and demographics on financial behavior.

4.2.4 Psychological and Cultural Factors

Personal and psychological traits are important factors in explaining financial behavior (Hastings et al., 2013) (Fernandes et al., 2014; Borghans and Golstyn, 2006) and other economic outcomes (Renneboog and Spaenjers, 2012; Guiso et al., 2003; Chen, 2013).

Along with financial literacy, some psychological factors can better explain financial behavior (Hastings et al., 2013; Fernandes et al., 2014; Borghans and Golstyn, 2006). In addition, psychological traits may solve for the omitted variables problem that makes financial literacy incapable of fully explaining the financial behavior of individuals. The proxies we choose for personal traits as determinants of financial behavior are confidence as suggested by Fernandes et al. (2014), impatience as proposed by (Hastings and Mitchell, 2011; Meier and Sprenger, 2010) and risk-taking as proposed by (Fernandes et al., 2014; Jianakoplos and Bernasek, 1998).

Meier and Sprenger (2013) find impatience as a psychological factor that influences financial behavior, where impatient people tend to make worse financial decisions. Impatience is measured through the concept of the discount factor, which is how willing an individual can value the future over the present. In addition, Gathergood and Weber (2014) show that impatience is associated with poor financial behavior.

Another psychological and self-efficacy trait is confidence in information search. It is linked to proactive use of information, processing and decision considerations (Bearden et al., 2001). In a meta-analysis financial literacy study by Fernandes et al. (2014), confidence has a positive effect on financial behavior.

A psychological trait that is previously used in the literature is the concept of individual risk-taking. Risk-taking is an important factor in wealth accumulation and investing in retirement plans. According to Jianakoplos and Bernasek (1998), lower levels of risk taken by women may account for the gender differences in wealth accumulation. Moreover, in a meta-analytic financial literacy study, risk-taking is associated with a better financial behavior in individuals (Fernandes et al., 2014). In our study, we include impatience, confidence and risk-taking as independent drivers of our financial behavior proxies.

Guiso et al. (2003) explore the effect of culture on economic outcomes, however, no previous studies have exclusively examined the impact of cultural traits on financial behavior in a financial literacy study. To explain the rationale behind the importance of cultural traits in determining financial behavior, we discuss some economic aspects of religion, religiosity and family ties.

Finance is an important subject in religion and is evident in the holy books of monotheistic religions. Weber (1904), in his book, *The Protestant Ethic and Spirit of Capitalism*, attributes the birth of capitalism to Protestantism, and specifically Calvinism. According to (Renneboog and Spaenjers, 2012), recent studies suggest that religiosity has a significant effect on the individual's economic attitudes such as trust in non-family members, planning and saving in the Netherlands. Renneboog and Spaenjers (2012) use religious affiliation as the way to measure religiosity. In previous studies, Protestants have stronger social ethics (Arrunada, 2010) where as Catholics are more able to control their subjective well-being than protestants (Renneboog and Spaenjers, 2012).

Keeping in mind that no financial literacy studies introduce religiosity as a determinant of financial behavior, the literature already uses religion as a determinant of economic outcomes. With no previous studies about how effective religiosity is compared with financial literacy in their effect on financial behavior, the previously discussed findings show that religion and religiosity may be the combined factors that influence financial outcomes (Guiso et al., 2003).

In a cultural study, Alesina and Giuliano (2014) study the effect of family ties strength on economic outcomes and find that strong family values are linked with lower political participation and action, lower trust levels to strangers, more interest in job security, less desire for innovation, and conservative attitudes toward working women.

The role of the family and family ties as a relevant variable that explains economic outcomes receives little attention in financial literacy studies. According to Banfield (1958); Coleman and Coleman (1994), societies that are based on strong ties among family members, tend to promote good conduct only within small circles related to family and kin. On the other hand, societies that are based on weak ties among family members are willing to promote good conduct among circles that are outside family and kin. This intuition is confirmed experimentally by (Gambetta, 1988). From this perspective, we introduce family ties as a potential determinant of financial behavior.

To summarize, religion, religiosity and family ties clearly have an influence on economic outcomes and these cultural factors are included in our study to test their effect on individual financial behavior in contrast with the effect of financial literacy on financial behavior.

4.3 Methodology

To estimate the model, we use a microeconomic cross sectional data set with information on five proxies of financial behavior (active saving, budgeting, punctual debt payment, stock market participation and saving for retirement), financial socialization by parents, numeracy, religiosity, family ties, impatience, confidence, measures of financial literacy and demographic variables. The survey is made of 59 close ended questions and is filled anonymously. The data is drawn from a survey collected in three different world regions based on different religions, family ties levels and native language differences. The survey is conducted in three languages (English, Portuguese and Spanish). We use the English questionnaire for the Arabic region, Germany and Holland. We use the English questionnaire for the Arabic region, Germany and Holland. The reason we use a questionnaire in English in Germany and Holland because English is a Germanic language. Also, according to Gordon Jr (2005), 90% of the Dutch, 56% of German and 45% of Lebanese population can speak in English. In addition, 50% of the Lebanese schools and 70% of the Lebanese universities use English as a language of instruction. In Lebanon, only 10% of schools teach in Arabic, which makes the use of a questionnaire about financial literacy in Arabic to be redundant. Yet, we consider that distributing a questionnaire in English to non-native English speaking countries is a limitation. That is, our results are restricted to our sample and survey language selection.

We choose our three regions based on their disparity in financial behavior as previously discussed in the literature

review.

The first region is the middle east where we collect our Arabic sample. The majority of the Arabic sample is from Lebanon, which is a good selection for religiosity and cultural differences across the country. We choose the Middle East to find the determinants of financial behavior among the Muslims and Christians in the region.

The second region is Latin Europe and the selection of respondents is from Spain and Portugal. We choose Spain and Portugal to find the determinants of financial behavior of Catholics. In addition, World Values Survey finds that family ties in Spain and Portugal are the strongest in comparison with other European countries.

The third region is Northern Europe where we collect responses from Germany and Holland. We choose Germany and Holland to find the determinants of financial behavior among Protestants. In addition, based on World Values Survey (WVS), Germany and Holland show weak family ties compared to other countries.

The survey is written and translated in three languages, English, Spanish and Portuguese. It is pre-tested by fifteen academic and research scholars before its distribution to respondents. Our survey questions and the techniques in constructing the variables to include in our analysis are presented in section 3.4.1 of the appendix.

Before we run our analysis, we eliminate the observations that do not belong to our geographic regions. We also apply Propensity Score Matching that eliminates observations that do not match the distribution of variables across Geographic sub samples. After the PSM and eliminating observations from countries outside our scope of interest, our sample constitutes of 600 observations which constitutes of 300 observations from the Arabic countries, 151 observations from the Latin European countries and 149 observations from the Germanic countries. Our power analysis results show that at a significance level of 5% and an estimation power of 85%, the minimum number of observations required per group is 66 which makes are sub-samples suitable for this comparative study.

H0 : There is no effect of financial literacy, numeracy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience, risk-taking) and demographics on our proxies of financial behavior

H1 : There is an effect of financial literacy, numeracy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience, risk-taking) and demographics on our proxies of financial behavior

H0 : There is no effect of cumulative financial literacy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience, risk-taking) and demographics on our proxies of financial behavior

H1 : There is an effect of cumulative financial literacy, financial socialization by parents, cultural factors (family ties, religiosity), psychological factors (confidence, impatience, risk-taking) and demographics on our proxies of financial behavior

H0 : There is no order of importance of financial literacy, numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics in affecting our proxies of financial behavior

H1 : There is an order of importance of financial literacy, numeracy financial socialization by parents, family ties, religiosity, confidence, impatience and demographics in affecting our proxies of financial behavior.

H0 : There is no order of importance of cumulative financial literacy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics in affecting our proxies of financial behavior

H1 : There is an order of importance of cumulative financial literacy, financial socialization by parents, family ties, religiosity, confidence, impatience and demographics in affecting our proxies of financial behavior.

We run OLS regressions using country fixed effects, IV regressions, GMM, Principal Component Analysis and Principal Component Regression. In addition, we apply Artificial Intelligence using machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. We use five proxies of financial behavior as our dependent variables (active saving, budgeting, punctual debt payment, stock market participation and saving for retirement) and our independent variables are two proxies of financial literacy, numeracy, financial socialization by parents, cultural variables (religiosity, family ties), psychological variables (impatience, confidence, risk-taking) and a vector of

demographics. The empirical models are formulated below.

$$\begin{aligned} finbeh_i = \alpha + \beta_1 finlit_i + \beta_2 numeracy_i + \beta_3 finsoc_i + \beta_4 ties_i + \\ \beta_5 religiosity_i + \beta_6 impatience_i + \beta_7 confidence_i + \beta_8 risk_i + \beta_9 X'_i + \varepsilon_i \end{aligned} \quad (4.3.1)$$

Where *finlit* is financial literacy, *fin_soc* is financial socialization, *ties* is family ties and *X'* is a vector of demographics.

$$\begin{aligned} finbeh_i = \alpha + \beta_1 cumfinlit_i + \beta_2 finsoc_i + \beta_3 ties_i + \\ \beta_4 religiosity_i + \beta_5 impatience_i + \beta_6 confidence_i + \beta_7 risk_i + \beta_8 X'_i + \varepsilon_i \end{aligned} \quad (4.3.2)$$

Where *cumfinlit* is cumulative financial literacy, *fin_soc* is financial socialization, *tie* is family ties and *X'* is a vector of demographics.

Our dependent variable presents five proxies for financial behavior which are active saving, budgeting, punctual debt payment, stock market participation and saving for retirement. In model 4.3.1, we use the financial literacy score independent from numeracy. In model 4.3.2, we use cumulative financial literacy score that is integrated with numeracy. The demographics are business/economics major at the university, age, gender, marital status, religion, education, geographic region and household income. A detailed explanation about measuring and aggregating our dependent and independent variables are presented in section 3.4.1 of the appendix.

We use OLS regression with country fixed effects to control for the omitted variable bias. To control for the endogeneity of financial literacy, we use Instrumental Variable regressions and the endogenous variables we choose are financial literacy and numeracy. The instruments we choose are mother's education, math skills at the age of 10, language proficiency and need for cognition (Grohmann et al., 2015; Fernandes et al., 2014; Behrman, Mitchell, Soo and Brava, 2012). In addition, to treat the heteroskedasticity problem, we also run a GMM model for robustness. We run two different regressions using our two proxies of financial literacy. To add robustness, we also apply our regressions

after eliminating one of the geographic regions' sub-samples each at a time. A detailed explanation on OLS with fixed effects, Instrumental Variables (IV) regression and Generalized Method of Moments (GMM) are available in section 2.5.1 in chapter 2.

In addition, we also run a Principal Component Analysis (PCA) and Principal Component Regression (PCR) due to the multi-dimensionality of the study. PCA and PCR are highly suitable for highly dimensional data just like ours. Our dependent variable is financial behavior and, in this model, we include every question related to our independent variables in the PCA. This methodology is used to reduce dimensions of the model by selecting a number of components that can describe the data. After we reduce the dimensions needed to explain the model, we run PCR on the selected components in order to estimate the coefficients of each variable affecting financial behavior. A discussion on PCA and PCR is available in section 3.3 in chapter 3.

Applying AI techniques is a different approach that can predict the determinants of financial behavior by importance. While most financial literacy studies use standard regression models, we believe that machine learning algorithms provide another insight on the determinants of behavior. We propose using three popular machine learning algorithms that suit our data set. The first algorithm used is Regression Trees which is suitable for continuous dependent variables and Classification Trees algorithm which is suitable for binary variables. In addition, we add robustness by using an unconditional Random Forest algorithm that provides better accuracy by averaging out a selected number of Regression Trees. Finally, we apply Quantile Regression Forests which can predict Regression Trees at different quantiles. In addition to the robustness that AI can add to our study, Regression Trees, Random Forest and Quantile Regression Forests analysis provide predictability power to rank our independent variables by importance. We run three machine learning algorithms and base our results on the algorithm with the lowest root mean square error. A more detailed explanation on why we use Artificial Intelligence in this study is available in section 3.3 in chapter 3.

To conclude, we use these three machine algorithms to (1) control for our highly dimensional data, (2) add robustness to our previous techniques such as OLS regression with fixed effects, Instrumental Variables regression, Generalized Method of Moments, Principal Component Analysis and Principal Component Regression and (3) predict the rank of importance of our independent variables in affecting financial behavior.

4.4 Data Description

To collect our data, we construct a questionnaire of 59 closed ended questions which are used as proxies for our dependent and independent variables. The questionnaire is uploaded using Google Forms in three languages (Spanish, Portuguese and English) and the data is collected between February and October 2017. The reason we use a questionnaire in English in Germany and Holland because English is a Germanic language. In addition, Lebanon which dominates our Arabic sub-samples use English as the language of instruction in schools and universities. From the collected 717 questionnaires, and after applying Propensity Score Matching and removing the respondents that are not within our Arabic, Latin European and Germanic sub-samples, 600 responses are used for our analysis (300 from the Arabic region, 149 from the Germanic region and 151 from the Latin European region). Because of the discrepancy between the three sub-samples, we run power analysis to find the sample size needed for this comparative study. at a significance level of 5% and an estimation power of 85%, the number of observations needed for every group is 66. Therefore, our sub-samples have enough observations for this comparative study.

We analyze our data using our five proxy measures of financial behavior which are active saving, budgeting, punctual debt payment, stock market participation and saving for retirement. More information about the construction of our dependent variables are presented in section 4.4.1. In addition, more information about constructing our proxies for the independent variables are presented in section 3.4.1.

4.4.1 Dependent and Independent Variables

Our dependent variables are five proxies of financial behavior which are active savings, budgeting, punctual debt payment, stock market participation and saving for retirement. The financial behavior questions are presented below:

- I have been actively saving for the future. (5 point Likert scale)
- I have a budget in place to manage my payments and expenses. (5 point Likert scale)
- I pay my fees and bills on time. (5 point Likert scale)
- Have you ever tried to figure out how much you need to save for retirement? (Yes/No)
- Have you ever invested in individual stocks (shares) or mutual funds? (Yes/No)

Our independent variables are two proxies of financial literacy, numeracy, financial socialization by parents, two proxies of family ties, religiosity, confidence, risk-taking, impatience and a vector of demographics.

Our proxy of risk-taking is:

- When thinking of my financial investments, I am willing to take risks (5 point Likert scale)

A detailed explanation of the rest of our independent variables proxies is available in section 3.4.1.

4.4.2 Descriptive Statistics

Table 4.1 presents the descriptive statistics of our selected continuous variables.

Table 4.1: Descriptive statistics of the continuous variables

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	600	4.182	1.202	1	5
financial socialization by parents	600	6.880	2.130	2	10
financial literacy	600	3.648	1.435	1	5
cumulative financial literacy	600	7.830	2.102	2	10
math at 10	600	3.862	0.956	1	5
religiosity	600	4.717	2.387	2	10
family ties	600	11.022	2.429	3	15
confidence	600	15.867	4.219	5	25
impatience	600	6.890	2.846	3	15
age	600	28.467	8.317	16	70
language proficiency	600	2.683	0.497	1	3
risk	600	2.902	1.080	1	5
active saving	600	3.217	1.311	1	5
budget	600	3.542	1.284	1	5
punctual debt payment	600	4.423	0.984	1	5
need for cognition	600	18.365	3.676	5	25

In figure 4.2, we find that our Latin European sub-sample is characterized by active saving, budgeting and punctual debt payment in comparison with our Germanic sub-sample (second) and Arabic sub-sample (third). Moreover, figure 4.3 shows that the Arabic sub-sample is more involved in saving for retirement in comparison with Germanic (second) and Latin Europeans (third). This can be attributed to the different pension and retirement systems in European countries

and the Middle East. Also, figure 4.4 shows that the Germanic and Latin sub-samples are more involved in investing in the stock market in comparison to the Arabic sub-sample.

Retirement Saving



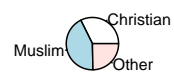
Stock Participation



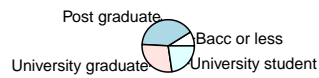
Sample distribution by gender



Sample distribution by religion



Sample distribution by education



Sample distribution by marital status



Figure 4.1: Pie charts for the categorical variables

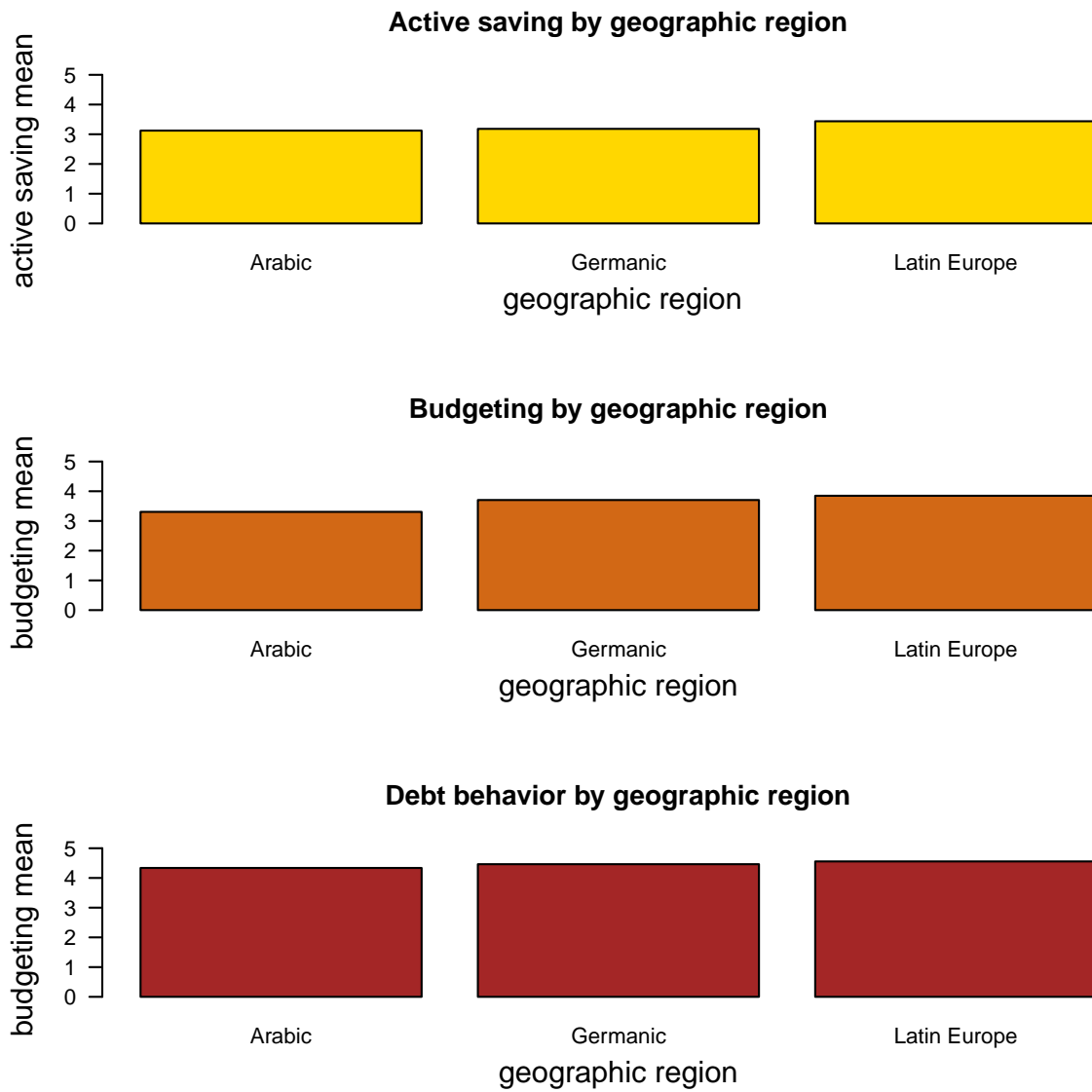


Figure 4.2: Active saving, budgeting and punctual debt payment by geographic region

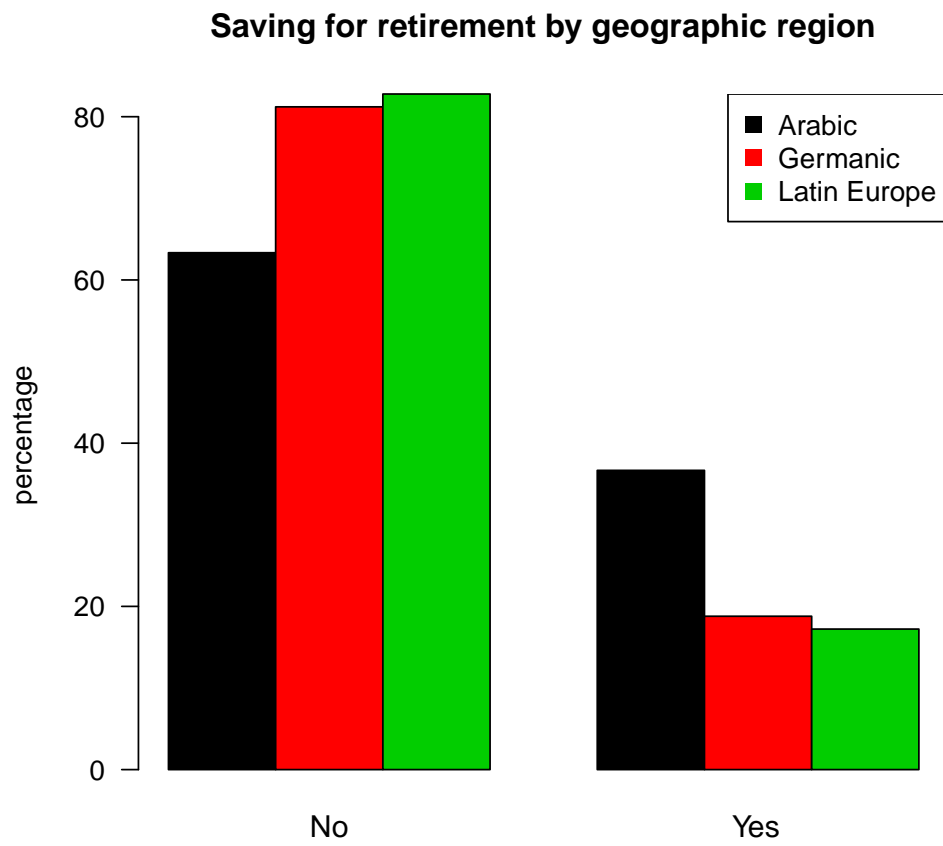


Figure 4.3: Saving for retirement by geographic region

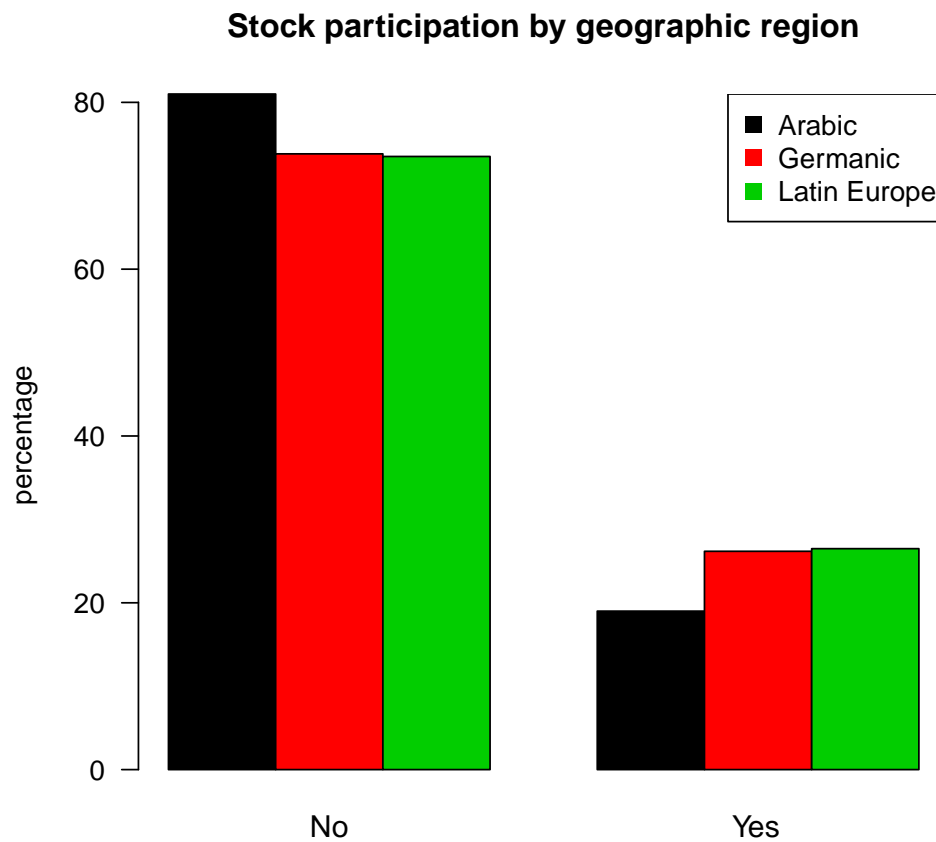


Figure 4.4: Stock participation by geographic region

Additional descriptive statistics are found in sections B.1 in appendix B and C.1 in appendix C. Since we are using the same data set used in chapter 3, more descriptive statistics regarding our independent variables can be found in section 3.4.2 in chapter 3.

4.5 Data Analysis

Before running the regression, we test for multi-collinearity and all the independent variables have a VIF below 4 which shows no multi-collinearity in the model. We present our analysis using different estimation and prediction techniques for five proxy measures of our financial behavior which are active saving, budgeting, punctual debt payment, stock

market participation and saving for retirement. The first technique we use is regression analysis which includes OLS with country fixed effects, Instrumental Variables regression and Generalized Method of Momentum. The residuals in our econometric models are normally distributed.

4.5.1 Active Saving

Tables 4.2 and C.4 present the regression results using active saving as a proxy for financial behavior. The first three columns present the results using our first proxy of financial literacy as an independent variable, whereas the latter three columns present the results using our second proxy of financial literacy as an independent variable.

In its effect on active saving, financial literacy weakens as we introduce psychological and cultural independent variables in the OLS regression. In the OLS, holding everything constant, as financial literacy increases by one standard deviation, active saving rises by 0.03 standard deviations and the result is statistically non-significant. When we apply IV regressions and GMM, financial literacy's effect on active saving becomes negative and statistically non-significant. We apply instrumental variables because of the endogeneity problem of financial literacy, which is presented in the literature. We use GMM, due to the heteroscedasticity problem of our regression models. In the GMM, an increase in one standard deviation in financial literacy leads to a decrease of 0.31 standard deviations in active saving. The result is statistically non-significant. The IV regression and GMM diagnostics presented in table 4.3 shows that the instruments used in our IV regression and GMM are valid. In our model, financial literacy does not seem to have a positive effect on active saving and perhaps other variables have more influence on our dependent variable. This result is different than previous studies on financial behavior, with the exception of the findings of (Fernandes et al., 2014). Our different results are attributed to the presence of psychological and cultural variables. Another reason for the different result can be attributed to the 600 observations we collected.

Numeracy has a negative effect on active saving in the OLS models. Using IV regressions and GMM show that numeracy has a negative effect on active saving. In the GMM, an increase in one standard deviation in numeracy leads to a decrease of 0.29 standard deviations in active saving. The result is statistically non-significant. Numeracy and financial literacy do not have a major effect on active saving in our model as opposed to most of the previous findings. However, financial literacy and numeracy can have a major influence when using the other proxies for financial behavior.

Table 4.2: Regression results using active saving as a proxy for financial behavior

Dependent variable: active saving	Financial Literacy			Cumulative Financial Literacy		
	GMM	IV	OLS	GMM	IV	OLS
financial literacy	-0.31 (0.24)	-0.08 (0.37)	0.03 (0.04)			
cumulative financial literacy				-0.28** (0.12)	-0.25** (0.13)	-0.02 (0.03)
numeracy	-0.29 (0.23)	-0.66 (0.48)	-0.08* (0.04)			
financial socialization	0.18*** (0.03)	0.13*** (0.04)	0.18*** (0.02)	0.18*** (0.03)	0.16*** (0.03)	0.18*** (0.02)
family ties	0.03 (0.03)	0.06 (0.04)	0.02 (0.02)	0.03 (0.02)	0.03 (0.03)	0.02 (0.02)
religiosity	0.05 (0.03)	0.04 (0.03)	0.05* (0.03)	0.04 (0.03)	0.04 (0.03)	0.05* (0.03)
impatience	-0.17*** (0.02)	-0.19*** (0.03)	-0.15*** (0.02)	-0.17*** (0.02)	-0.17*** (0.02)	-0.15*** (0.02)
confidence	0.05*** (0.02)	-0.00 (0.05)	0.03** (0.01)	0.05*** (0.02)	0.04** (0.02)	0.03** (0.01)
risk-taking	0.09 (0.06)	0.80 (0.62)	0.06 (0.05)	0.09 (0.05)	0.08 (0.05)	0.07 (0.05)
age	0.00 (0.01)	0.03 (0.02)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
gender: male	-0.22 (0.14)	-0.46* (0.24)	-0.36*** (0.11)	-0.25* (0.13)	-0.27** (0.12)	-0.35*** (0.11)
business/economics at university: yes	0.15 (0.14)	0.06 (0.19)	-0.01 (0.12)	0.14 (0.14)	0.11 (0.14)	-0.01 (0.12)
education: Post graduate	0.24 (0.17)	0.32 (0.28)	0.11 (0.19)	0.26 (0.16)	0.17 (0.20)	0.12 (0.19)
education: University graduate	0.20 (0.21)	0.37 (0.32)	0.13 (0.20)	0.23 (0.18)	0.19 (0.21)	0.15 (0.20)
education: University student	0.18 (0.19)	0.44 (0.34)	0.13 (0.20)	0.17 (0.18)	0.20 (0.22)	0.14 (0.20)
geographic region: Germanic	0.75*** (0.27)	0.35 (0.26)	0.31* (0.19)	0.71*** (0.25)	0.31 (0.20)	0.29 (0.19)
geographic region: Latin Europe	0.09 (0.20)	0.42 (0.34)	0.22 (0.21)	0.07 (0.18)	0.20 (0.22)	0.21 (0.21)
religion: Muslim	0.04 (0.19)	-0.02 (0.25)	0.17 (0.17)	0.03 (0.19)	0.04 (0.19)	0.16 (0.17)
religion: Other	0.12 (0.13)	0.09 (0.19)	0.02 (0.14)	0.10 (0.13)	0.07 (0.15)	0.01 (0.14)
household income: 2000-3999	0.41* (0.22)	0.26 (0.28)	0.21 (0.13)	0.39** (0.16)	0.36** (0.15)	0.24* (0.13)
household income: 500-1000	0.11 (0.21)	-0.03 (0.27)	-0.09 (0.15)	0.08 (0.16)	0.02 (0.16)	-0.07 (0.15)
household income: less than 500	0.13 (0.29)	0.20 (0.35)	0.14 (0.21)	0.16 (0.22)	0.15 (0.22)	0.18 (0.21)
household income: more than 4000	0.42* (0.25)	0.22 (0.32)	0.10 (0.15)	0.38* (0.21)	0.33* (0.20)	0.12 (0.15)
marital status: Other	0.54* (0.28)	0.46 (0.38)	0.36 (0.27)	0.48* (0.28)	0.48 (0.30)	0.37 (0.27)
marital status: Single	0.23 (0.17)	0.36 (0.23)	0.15 (0.14)	0.23 (0.16)	0.22 (0.16)	0.14 (0.14)
Criterion function	858.48			519.99		
R ²		0.11	0.26		0.19	0.26
Adj. R ²		0.05	0.22		0.14	0.21
Num. obs.	600	600	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions

We get similar results after removing the sub-samples one at a time

Standard errors are between parentheses

Table 4.3: Diagnostics for IV Regressions and GMM in table 4.2 using active saving as a dependent variable

Diagnostics for IV regression using financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	8	560	2.687	6.62e-03***
Weak instruments (numeracy)	8	560	3.426	7.36e-04***
Wu-Hausman	2	564	3.010	5.00e-02*
Sargan	6	NA	5.153	0.52433
Diagnostics for GMM using financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
			J-test	p-value
Test E(g)=0:			4.92101	0.55398
Instrumented: financial literacy, numeracy Instruments: math at 10, mother education, language proficiency				
Diagnostics for IV regression using cumulative financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (cumulative financial literacy)	7	560	4.478	7.26e-05***
Wu-Hausman	1	565	4.862	2.79e-02**
Sargan	6	NA	3.299	0.7705
Diagnostics for GMM using cumulative financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
			J-test	p-value
Test E(g)=0:			3.13815	0.79132
Instrumented: cumulative financial literacy Instruments: math at 10, mother education				

Most of the previous studies show a positive effect of financial literacy and numeracy on financial behavior as opposed to our results using active saving as a proxy for financial behavior. The presence of confidence, impatience, risk, family ties and religiosity as independent variables can play a more important role than financial literacy and numeracy in influencing our proxy for financial behavior.

Financial socialization by parents shows a strong influence on active saving in our regression models. In the OLS regression, an increase in one standard deviation in financial socialization leads to an increase of 0.18 standard deviations in active saving. In addition, the GMM result shows that an increase in one standard deviation in financial socialization leads to an increase of 0.18 standard deviations in active saving. The results are significant. These results are consistent with the findings in previous research.

Our independent variable proxies for culture are family ties and religiosity. Our proxy for family ties has a positive and statistically non-significant coefficient. In the GMM, an increase in one standard deviation in family ties raises active saving by 0.03 standard deviations and the result is statistically non-significant. In addition, religiosity also shows a sig-

nificant and positive impact on active saving. In the OLS regression, an increase in one standard deviation in religiosity leads to an increase of active saving by 0.05 standard deviations and the result is significant. In the IV regression the effect falls to 0.04 and becomes statistically non-significant. In addition, the GMM results show that an increase in one standard deviation of religiosity increases active saving by 0.05 standard deviations and the result is significant. Our new findings show that cultural factors can solve for the omitted variable bias in financial literacy studies in finding the determinants of financial behavior.

The next set of independent variables in our empirical models are the three proxies for psychological behavior which are confidence, impatience and risk-taking. In the OLS, IV regression and GMM, impatience has a significant and negative effect on active saving. In the GMM, holding everything constant, an increase in one standard deviation of impatience leads to a decrease of 0.17 standard deviations in active saving. The results are significant for impatience across the OLS, IV regression and GMM. Confidence has a positive influence on active saving and the results are significant in the OLS regression and GMM. In the GMM, an increase in one standard deviation in confidence raises active saving by 0.05 standard deviations and the result is significant. Moreover, risk-taking has a positive effect on active saving and the result is statistically non-significant. That is, in the GMM estimate, an increase in one standard deviation of risk-taking raises active saving by 0.09 standard deviation and the result is statistically non-significant. The results of our psychological traits comply with the previous empirical studies. Our findings also show the importance of psychological factors in influencing our first proxy for financial behavior. Our results show that the cultural factors and psychological traits have a stronger influence than financial literacy on active saving.

When it comes to demographics, females have higher level of active saving than males, Muslim have a higher level of active saving than Christians and Germanic individuals have higher active saving than Latin European and Arabic individuals. A higher education level is also associated with higher active saving.

We also repeat the regressions using another proxy for financial literacy, which combines numeracy. The R squared of this model is lower and the results are similar to our findings. The results using the second proxy for financial literacy are presented in columns 4,5 and 6 of table 4.2. To conclude our regression findings for active saving as dependent variable, our cultural, psychological and demographic variables show a stronger influence than financial literacy on financial behavior. Our findings provide a new contribution to the literature in financial literacy studies.

To add robustness to our regression findings of our first proxy for financial behavior as dependent variable, we apply Principal Component Analysis and Principal Component Regression. PCA and PCR solve the problem of having multi-dimensional data which is present in this study. Hence, instead of relying on the aggregate score of independent variables, we include every question related to our proxies for the independent variables as a unique independent variable. Before conducting our PCA and PCR, we check for internal consistency in all our survey questions using the Cronbach alpha test. All the variables have a standardized alpha between 0.59 and 0.66 which shows an internal consistency in the survey questions. When we apply PCA while using financial literacy score as dependent variable, we find that the error drastically falls at the 10th component. The results show that 10 components explain 74.68% of the model. To verify our choice of using 10 components, we conduct parallel analysis which predicts the number of components that are needed to explain the model. Parallel analysis, that is presented in figure 4.5 suggests using 10 principal components.

After choosing the number of components needed, we run a Principal Component Regression. The regression uses the 10 components as independent variables and extracts the coefficients for every question in our survey. This analysis is limited to the continuous variables in the sample. The results of active saving as dependent variable are presented in the first column of table 4.20.

The results show that, on aggregate, financial socialization, religiosity, family ties, risk and confidence positively affect active saving. Also, numeracy scores, financial literacy and increased age are negatively associated with active saving. We also apply PCA and PCR using another proxy for financial literacy which includes numeracy and the results are similar. The results of our PCR using cumulative financial literacy as an independent variable which are consistent with econometric model 4.3.1 are presented in table 4.21.

In addition to OLS, IV regressions, GMM, PCA and PCR which are estimate models, we introduce Artificial Intelligence as predictive algorithms to our model. The machine learning algorithms we use are Regression and Classification Trees, Random Forest and Quantile Regression Forests. These algorithms provide the power to predict the important drivers of financial behavior. We start applying AI techniques using active saving as our first proxy for financial behavior. We use 80% of our sample as training data set and 20% as testing and validation data set. After pruning the data, the

algorithm suggests a maximum number of splits of 4.

Our first machine learning algorithm which is Regression Trees shows that the most important drivers of active saving are financial socialization, impatience, confidence, age, financial literacy, household income and family ties, religion and religiosity. The result complies with our regression, PCA and PCR findings and adds robustness to the fact that psychological and cultural factors are important drivers of financial behavior. We also run Regression Trees using another proxy for financial literacy which includes numeracy and the results are similar to our findings. Our results of all our Regression Trees are presented in table 4.5.

Our second machine learning algorithm is a more accurate approach to Regression Trees. Random Forest analysis is a solution for reducing the variance of the Regression Trees model. In Random Forests, the idea is to lower the correlation of several Regression Trees which are generated on the different bootstrapped samples from training Data. The variance is reduced by averaging the generated sample trees. We use a pruning result of 500 trees to predict our model.

Using active saving as the dependent variable which is our first proxy for financial behavior, we find that the main predictors of active saving are impatience, financial socialization, confidence, gender, religiosity, geographic region, family ties, age, religion, risk-taking, household income, education, financial literacy, studied business/economics at university, marital status and numeracy. The results and diagnostics are presented in table 4.4 The results are also compliant to our Regression Trees findings.

Table 4.4: Random Forest independent variable importance for active saving

Independent variable	Inc.MSE
impatience	0.290
financial socialization	0.272
confidence	0.060
gender	0.042
religiosity	0.039
geographic region	0.035
family ties	0.025
age	0.023
religion	0.022
risk	0.022
household income	0.021
education	0.018
financial literacy	0.017
business/economics at university	0.012
marital status	0.005
numeracy	0.001

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the selected minimum number of splits is 4. The number of trees is 500. The R squared for this Random Forest is 28.04% and the mean squared error is 1.12. The predictability shows an R squared of 22.8% and the MSE is 1.38. Another Random Forest using another proxy for financial literacy that includes numeracy shows similar results.

Our third machine learning algorithm is Quantile Regression Forests. This approach offers a non-parametric approach of estimating conditional quantiles of predictor variables. Our quantiles are 5%,25%,50%,75% and 95%. Our results using active saving as a dependent variable are at the 50th quantile, the main predictors of active saving are impatience, financial socialization, confidence, household income, age, religiosity, family ties, risk-taking and geographic region. Again, the findings are consistent over the three machine learning algorithms. Our results of all our Quantile Regression Forests are presented in table 4.5.

Among the three machine learning algorithms, the one with the lowest MSE is the Random Forest approach and it will be our main method for analyzing the data. So, based on Random Forest approach, we find that the main predictors of active saving are impatience, financial socialization, confidence, gender, geographic region, religiosity, household income and family ties.

We also run the three machine learning algorithms using cumulative financial literacy and the results are similar and presented in table 4.5.

Table 4.5: Summary of the three machine learning algorithms using Active Saving as a dependent variable

Dependent Variable: Active Saving						
Rank	Using Financial Literacy as an Independent Variable			Using Cumulative Financial Literacy as an Independent Variable		
	Random Forest	Regression Trees	Quantile Regression Forests	Random Forest	Regression Trees	Quantile Regression Forests
1	impatience	financial socialization	financial socialization	financial socialization	financial socialization	impatience
2	financial socialization	impatience	impatience	impatience	impatience	financial socialization
3	confidence	household income	confidence	confidence	confidence	confidence
4	gender	age	age	gender	cumulative financial literacy	household income
5	religiosity	family ties	family ties	religiosity	risk-taking	age
6	geographic region	confidence	religiosity	geographic region	household income	religiosity
7	family ties	geographic region	geographic region	cumulative financial literacy	religion	family ties
8	age	religion	household income	family ties	family ties	risk-taking
9	religion	financial literacy	religion	religion	age	cumulative financial literacy
10	risk-taking	education	risk-taking	household income	religiosity	religion
11	household income	religiosity	gender	age	geographic Region	geographic Region
12	education	risk-taking	financial literacy	education	gender	gender
MSE/Error Rate	1.38	1.84	2.81	1.53	1.90	3.17

We use OLS, IV regression, GMM, PCA and PCR to find our determinants of active saving. We also use three machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. Our results are consistent over the different techniques and show that financial socialization, psychological factors (impatience, confidence) and cultural traits (family ties) are the main determinants and predictors of active saving. In the regressions, financial literacy (only in the OLS), numeracy (only in the OLS), family ties, religiosity, confidence, risk-taking, education, Germanic individuals, household income and females are positively attributed to active saving. Moreover, impatience is negatively associated with active saving. Using the Random Forest algorithm, we find that the main predictors of active saving are impatience, financial socialization, confidence, gender, geographic region, religiosity, household income and family ties.

Contradictory to previous findings, financial literacy and numeracy show negative effects on active saving in the IV regression and GMM. Financial socialization, confidence, risk-taking, family ties and religiosity have a positive effect on active saving, whereas impatience has a negative effect on financial behavior. Financial socialization by parents is to be the most important driver of active saving in our study. Therefore, educating parents about how important it is to financially socialize with their children is a good tool for improving financial behavior. Moreover, the importance of psychological factors on financial behavior can highlight the importance of promoting psychological health to individuals as an attempt to improve financial behavior.

4.5.2 Budgeting

In this section, we present the analysis of our second dependent variable which is the individual ability for budgeting. The regression analysis using budgeting as a proxy for financial behavior is presented in tables 4.6 and C.5.

Similar to our analysis of the previous section, we run OLS regressions, Instrumental Variable regression, Generalized Method of Momentum, Principal Component Analysis, Principal Component Regression, Regression Trees, Random Forest and Quantile Regression Trees. Our independent variables are aggregates of financial socialization by parents, numeracy, financial literacy (two proxies), family ties, religiosity, confidence, impatience, risk-taking and a vector of demographics which include age, gender, education, religion, geographic location (three categories), marital status, business/economics education at the university and household income. Our dependent variable is budgeting. In our survey, budgeting has a 5 point Likert scale which asks if the individual has a budget in place to manage payments and expenses where 1 is strongly disagree and 5 is strongly agree.

We start with our regression analysis by using OLS with country fixed effects, IV regression and GMM. We use instrumental variables due to the endogeneity problem of financial literacy and GMM due to the heteroscedasticity problem of our empirical model. The regression analysis is suitable for estimating the determinants of our financial behavior proxy which is budgeting. The results of our budgeting regression analysis are presented in table 4.6 and our diagnostics for instrumental variables and GMM are presented in table 4.7.

Financial literacy does not have significance in the OLS regressions, however, once we introduce instrumental variables, financial literacy shows a positive and significant effect on budgeting. In the GMM, an increase in one standard deviation in financial literacy raises budgeting by 0.85 standard deviations. The result is significant and complies with previous empirical works. On the other hand, numeracy shows a positive and statistically non-significant effect in the IV regressions and GMM. That is, in the GMM an increase in one standard deviation in numeracy leads to an increase in 0.06 standard deviations in budgeting. Financial socialization by parents has a positive and significant on budgeting. In the GMM, an increase in one standard deviation in financial socialization by parents raises budgeting by 0.17 standard deviations and the result is significant. Our regression results show that financial literacy, numeracy and financial socialization by parents are positive and strong determinants of budgeting. These results are similar to previous empirical studies on finding the determinants of financial behavior.

Concerning our cultural factors, our proxy for family ties has a negative effect on budgeting but the result is statistically non-significant. However, religiosity shows a positive and significant effect on budgeting. In the GMM, an increase of one standard deviation in family ties lowers budgeting by 0.01 standard deviations and the result is statistically non-

Table 4.6: Regression results using budgeting as a proxy of financial behavior

Dependent variable: budgeting	Financial Literacy			Cumulative Financial Literacy		
	GMM	IV	OLS	GMM	IV	OLS
financial literacy	0.85*** (0.27)	0.85*** (0.30)	-0.01 (0.04)			
cumulative financial literacy				0.47** (0.20)	0.59** (0.24)	-0.00 (0.03)
numeracy	0.06 (0.32)	0.15 (0.40)	0.01 (0.04)			
financial socialization	0.17*** (0.04)	0.18*** (0.04)	0.15*** (0.03)	0.16*** (0.03)	0.18*** (0.04)	0.15*** (0.03)
family ties	-0.01 (0.04)	-0.01 (0.04)	-0.00 (0.02)	-0.03 (0.03)	-0.03 (0.03)	0.00 (0.02)
religiosity	0.09*** (0.03)	0.10*** (0.04)	0.09*** (0.03)	0.09*** (0.03)	0.10*** (0.04)	0.09*** (0.03)
impatience	-0.06** (0.03)	-0.06** (0.03)	-0.11*** (0.02)	-0.07*** (0.03)	-0.07** (0.03)	-0.11*** (0.02)
confidence	0.02 (0.02)	0.02 (0.03)	0.05*** (0.01)	0.02 (0.02)	0.01 (0.02)	0.05*** (0.01)
risk-taking	-0.03 (0.08)	-0.02 (0.07)	0.05 (0.05)	-0.00 (0.07)	-0.00 (0.07)	0.05 (0.05)
age	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
gender: male	-0.28 (0.17)	-0.29* (0.18)	-0.05 (0.11)	-0.24 (0.15)	-0.26 (0.17)	-0.05 (0.11)
business/economics at university: yes	-0.32* (0.19)	-0.35 (0.22)	-0.08 (0.12)	-0.36** (0.17)	-0.41* (0.21)	-0.08 (0.12)
education: Post graduate	-0.25 (0.25)	-0.14 (0.28)	0.04 (0.19)	-0.24 (0.22)	-0.10 (0.27)	0.03 (0.19)
education: University graduate	-0.22 (0.28)	-0.18 (0.30)	0.07 (0.20)	-0.05 (0.24)	-0.04 (0.28)	0.06 (0.20)
education: University student	-0.28 (0.26)	-0.28 (0.29)	-0.08 (0.20)	-0.19 (0.23)	-0.23 (0.28)	-0.08 (0.20)
geographic region: Germanic	-0.27 (0.43)	0.07 (0.28)	-0.00 (0.19)	-0.11 (0.40)	-0.05 (0.26)	-0.00 (0.19)
geographic region: Latin Europe	0.60** (0.25)	0.06 (0.30)	0.00 (0.21)	0.47** (0.20)	0.03 (0.29)	0.00 (0.21)
religion: Muslim	0.52** (0.24)	0.64** (0.27)	0.30* (0.17)	0.56*** (0.21)	0.62** (0.27)	0.30* (0.17)
religion: Other	0.25 (0.19)	0.26 (0.21)	0.35** (0.14)	0.22 (0.17)	0.21 (0.20)	0.35** (0.14)
household income: 2000-3999	-0.57** (0.24)	-0.51** (0.25)	-0.02 (0.13)	-0.35* (0.18)	-0.34 (0.22)	-0.02 (0.13)
household income: 500-1000	-0.64*** (0.25)	-0.55** (0.26)	-0.15 (0.15)	-0.42** (0.20)	-0.36 (0.22)	-0.15 (0.15)
household income: less than 500	-0.56* (0.33)	-0.39 (0.36)	-0.17 (0.21)	-0.23 (0.23)	-0.10 (0.29)	-0.18 (0.21)
household income: more than 4000	-0.76*** (0.28)	-0.70** (0.32)	-0.04 (0.16)	-0.53** (0.26)	-0.58* (0.30)	-0.05 (0.15)
marital status: Other	-0.59 (0.42)	-0.49 (0.41)	-0.16 (0.28)	-0.47 (0.35)	-0.44 (0.40)	-0.17 (0.28)
marital status: Single	0.09 (0.20)	0.13 (0.22)	0.26* (0.14)	0.07 (0.19)	0.05 (0.21)	0.26* (0.14)
Criterion function	684.41			1351.92		
R ²		0.04	0.20		0.05	0.20
Adj. R ²		-0.02	0.16		-0.01	0.16
Num. obs.	600	600	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions

We get similar results after removing our sub-samples one at a time

Standard errors are between parentheses

Table 4.7: Diagnostics for IV Regression and GMM in table 4.6 using budgeting as a dependent variable

Diagnostics for IV regression using financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	8	560	2.166	2.849e-02**
Weak instruments (numeracy)	8	560	1.757	8.28e-02*
Wu-Hausman	2	564	8.309	2.78e-04***
Sargan	6	NA	4.022	0.673765
Diagnostics for GMM using financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
			J-test	p-value
Test E(g)=0:			4.73644	0.57803
Instrumented: financial literacy, numeracy Instruments: need for cognition, mother education, languages proficiency				
Diagnostics for IV regression using cumulative financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (cumulative financial literacy)	7	560	1.873	7.16e-02*
Wu-Hausman	1	565	9.923	1.72e-03**
Sargan	6	NA	7.220	0.30098
Diagnostics for GMM using cumulative financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
			J-test	p-value
Test E(g)=0:			9.20411	0.16242
Instrumented: cumulative financial literacy Instruments: need for cognition, mother education				

significant. Moreover, *ceteris paribus*, the GMM estimate shows that an increase in one standard deviation in religiosity raises budgeting by 0.09 standard deviations and the result is significant. Individuals in religious groups may have a proper environment that promotes budgeting.

When it comes to our psychological drivers, impatience has a negative effect on budgeting. In the GMM, an increase in one standard deviation of impatience lowers budgeting behavior by 0.06 standard deviations and the result is significant. Confidence is positively correlated with budgeting but risk-taking is negatively correlated. The results for risk-taking and confidence are statistically non-significant.

Demographics show that with increased age, individuals budget more and females are better in budgeting than males. Also, Latin Europeans budget better than Arabs and Muslims budget better than Christians.

We also repeat the regressions using another proxy for financial literacy which includes numeracy. The R squared of this model is lower and the results are similar to our findings. The results using the second proxy for financial literacy

are also presented in table 4.6.

To conclude our regression analysis, financial literacy, numeracy, financial socialization by parents, confidence, religiosity and age are positive drivers of our second proxy for financial behavior. Impatience and family ties is a negative driver of budgeting, Muslims budget better than Christians and females budget better than males.

In our next step we apply Principal Component Analysis and Principal Component Regression. PCA is suitable for analyzing multi-dimensional data. Instead of aggregating our independent variables, we use every question related to our independent variables as a unique independent variable. When we conduct our PCA, we find that 10 components are suitable for explaining the data. Ten components describe 75% of the data. To justify using 10 components, we run parallel analysis that shows that the number of components needed to explain the data is 10. Parallel analysis is presented in figure 4.5. After conducting PCA, we perform Principal Component Regression using the 10 components as independent variables and budgeting being our dependent variables. PCA and PCR are restricted to continuous variables. The results of our PCR are presented in the second column of tables 4.20 and 4.21. The results show that financial literacy, financial socialization by parents, numeracy, religiosity, confidence and age have a positive effect on budgeting. On the other hand, impatience and family ties have a negative effect on budgeting. The results are similar to our regression analysis except numeracy and family ties which have a positive effect in the IV regression and GMM.

In addition to the regression analysis, PCA and PCR, we apply Artificial Intelligence techniques that include three machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. The advantage of using machine learning techniques lies in the ability to predict the drivers of our dependent variable by incremental mean squared error importance.

The first machine learning algorithm we use is Regression Trees. We prune the data by using a maximum tree splits of four. The Regression Trees result shows that impatience, confidence, financial socialization, financial literacy, geographic region, age, religion, household income and family ties are the most important predictors of budgeting. This result is compliant with previous financial behavior studies. That is, financial literacy and financial socialization are important drivers of financial behavior. In addition, psychological factors are also important factors in predicting financial behavior. Based on this result, improving the individual's ability to budget income and expenses can be reached with

increasing financial literacy and financial socialization by parents. Moreover, better mental health can lead to better financial behavior. The results of our Regression Trees are presented in table 4.9.

Our second machine learning algorithm is Random Forest and it is a more complex algorithm than Regression Trees. It relies on averaging out multiple Regression Trees by using incremental mean squared error. We prune our data using 500 trees and a maximum tree split of 4. The Random forest results and diagnostics for budgeting are available in table 4.8. The findings show that the most important predictors of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business/economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status. The results are compliant with our Regression Trees results. Knowing that Random Forest has the lowest MSE across our three algorithms. We base our conclusions on Random Forests.

Table 4.8: Random Forest independent variable importance for budgeting

Independent variable	Inc.MSE
impatience	0.228
financial socialization	0.204
geographic region	0.058
confidence	0.051
religiosity	0.022
business/economics at university	0.020
risk	0.018
gender	0.017
education	0.017
religion	0.016
numeracy	0.013
family ties	0.009
age	0.008
financial literacy	0.008
household income	0.005
marital status	0.002

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the selected minimum number of splits is 4. The number of trees is 500. The R squared for this Random Forest is 22.5% and the mean squared error is 1.12. The predictability shows an R squared of 16.3% and the MSE is 1.48. Another Random Forest using another proxy for financial literacy that combines numeracy shows similar results.

The last machine learning algorithm is Quantile Regression Forests. This approach offers a non-parametric approach of estimating conditional quantiles of predictor variables. Our quantiles are 5%,25%,50%,75% and 95%. The QRF results show that at the 50th quantile, the most important predictors of budgeting are impatience, financial socialization, confidence, geographic location, household income, age, family ties, risk-taking and religion. The results are similar to

the previous machine learning algorithms. The results of our Quantile Regression Forests are presented in table 4.9.

We also run the three machine learning algorithms using cumulative financial literacy and the results are similar and presented in table 4.9.

Table 4.9: Summary of the three machine learning algorithms using Budgeting as a dependent variable

Dependent Variable: Budgeting						
	Using Financial Literacy as an Independent Variable			Using Cumulative Financial Literacy as an Independent Variable		
Rank	Random Forest	Regression Trees	Quantile Regression Forests	Random Forest	Regression Trees	Quantile Regression Forests
1	impatience	impatience	impatience	financial socialization	impatience	impatience
2	financial socialization	financial socialization	financial socialization	impatience	financial socialization	financial socialization
3	geographic region	confidence	confidence	geographic region	cumulative financial literacy	confidence
4	confidence	risk-taking	geographic region	confidence	confidence	geographic region
5	religiosity	household income	family ties	cumulative financial literacy	age	household income
6	business/economics at university	age	age	religiosity	family ties	age
7	risk	financial literacy	risk-taking	religion	risk-taking	family ties
8	gender	education	financial literacy	gender	geographic region	religiosity
9	education	geographic region	household income	household income	religiosity	risk-taking
10	religion	religiosity	religion	family ties	religion	cumulative financial literacy
11	numeracy	family ties	religiosity	education	household income	education
12	family ties	gender	gender	business/economics at university	education	religion
MSE/Error Rate	1.48	1.82	2.9	1.59	1.94	3.16

In conclusion, we find that using our different empirical approaches, financial literacy, numeracy (only in the OLS) financial socialization, Latin Europeans, religiosity, Muslims and confidence have a positive effect on budgeting. In addition, impatience and males have a negative effect on budgeting. Using Random forest algorithm, we find that the main drivers of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business/economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status.

4.5.3 Punctual Debt Payment

Similar to the models in sections 4.5.2 and 4.5.1, we use the same empirical analysis using one proxy for punctual debt payment which is paying debts on time. The question on punctual debt payment is a 5 point Likert scale. The statement is: "I pay my fees and bills on time" where 1 is strongly disagree and 5 is strongly agree.

We start our analysis with OLS regression with fixed effects, IV regression and GMM. Our regression results are presented in tables 4.10 and C.6 and the Instrumental variable and GMM diagnostics are presented in table 4.11. Financial literacy shows a positive coefficient in the OLS with country fixed effects and a positive and statistically non-significant coefficient in the IV regression and GMM. In the OLS, an increase in one standard deviation in financial literacy increases

our proxy for punctual debt payment by 0.09 standard deviations and the result is significant. However, after applying instrumental variables, the GMM shows that an increase in one standard deviation in financial literacy raises punctual debt payment by 0.18 standard deviations and the result is statistically non-significant. The instrumental variable diagnostics in table 4.11 shows that the instruments we use are valid.

On the other hand, numeracy has a positive coefficient in both the OLS and Instrumental variables regression. In the GMM, an increase in one standard deviation in numeracy raises paying on time by 0.51 standard deviations. The result is significant. Also, financial socialization by parents is also positively correlated and significant with paying on time in the OLS, IV regression and GMM. In the GMM, an increase in one standard deviation in financial socialization by parents increases paying on time behavior by 0.06 standard deviations and the result is significant. The effects of financial literacy, numeracy and financial socialization in our study are similar to the previous empirical studies.

Our cultural variables are family ties and religiosity. In the OLS, IV reg and GMM, family ties are positively associated with punctual debt payment. In the GMM, an increase in one standard deviation of family ties raises paying on time proxy for punctual debt payment by 0.07 standard deviations and the result is significant. Regarding religiosity, the coefficient is positive and significant in the OLS and GMM. Using the GMM result, an increase in one standard deviation in religiosity raises paying on time behavior by 0.05 standard deviations and the result is significant. These findings show how important cultural factors are in influencing punctual debt payment. This result can suggest new financial education implementations that can target family cultural values to improve punctual debt payment.

Concerning our psychological factors, impatience has a negative and significant coefficient in the OLS where an increase in one standard deviation of impatience lowers our proxy for punctual debt payment by 0.02 standard deviations and the result is significant. In the GMM result, impatience has no effect on punctual debt payment. Also, confidence has a positive coefficient over the regressions. In the GMM, an increase in confidence by one standard deviations, raises the punctual debt payment by 0.02 standard deviations and the result is statistically non-significant. In addition, risk-taking is negatively associated with paying debt on time but the result is not significant. In the GMM, an increase in one standard deviation of risk-taking lowers paying debt on time by 0.07 standard deviations and the result is statistically non-significant.

The demographic results show that females have a better punctual debt payment than males, Germanic individuals have a better punctual debt payment than Arabic and Latin European individuals, Christians have a better punctual debt payment than Muslims and higher education level leads to better punctual debt payment.

We also repeat the regressions using another proxy for financial literacy which entails numeracy. The R squared of this model is lower and the results are similar to our findings. The results using the second proxy for financial literacy are presented in table 4.10.

To conclude, we find that cultural variables and psychological determinants better explain our proxy for punctual debt payment in our model. Financial literacy, numeracy, financial socialization, family ties, religiosity and confidence are positively associated with the paying on time behavior. Impatience and risk are negatively associated with our proxy of punctual debt payment. Impatience in the OLS but has no effect in the IV regression and GMM. This finding is compliant with previous findings in the literature and gives an additional insight about the importance of cultural variables in improving financial behavior.

We run Principal Component Analysis and Principal Component regression on the whole set of survey questions related to our independent variables. The parallel analysis in figure 4.5 show that 10 components sufficiently explain the data. Then we regress the 10 components to extract the coefficients for every independent variable questions in its effect on punctual debt payment. The PCR results of punctual debt payment are available in the third column of tables 4.20 and 4.21. The results show that financial literacy, numeracy, confidence, family ties, financial socialization, religiosity and age have a positive effect on punctual debt payment. Moreover, weak family ties, impatience and risk-taking have a negative effect on punctual debt payment.

We then apply Artificial Intelligence techniques by using our three machine learning algorithms which are Regression Trees, Random Forest and Quantile Regression Forests. The Regression Trees plot at a maximum tree split of 4. The Regression Trees findings show that the most important predictors of punctual debt payment in our model are family ties, age, financial literacy, financial socialization, impatience, confidence, household income and numeracy. That is, financial literacy, financial socialization, numeracy, psychological and cultural factors are all important predictors of punctual debt payment. Our results of our Regression Trees are presented in table 4.13.

Table 4.10: Results using punctual debt payment as a proxy for financial behavior

Dependent variable: Punctual Debt Payment	Financial Literacy			Cumulative Financial Literacy		
	GMM	IV	OLS	GMM	IV	OLS
financial literacy	0.18 (0.21)	0.16 (0.21)	0.09*** (0.03)			
cumulative financial literacy				0.31** (0.15)	0.33** (0.15)	0.07*** (0.02)
numeracy	0.51** (0.25)	0.67** (0.28)	0.03 (0.03)			
financial socialization	0.06*** (0.02)	0.09*** (0.03)	0.07*** (0.02)	0.07*** (0.02)	0.08*** (0.02)	0.07*** (0.02)
family ties	0.07** (0.03)	0.07** (0.03)	0.10*** (0.02)	0.08*** (0.02)	0.09*** (0.02)	0.10*** (0.02)
religiosity	0.05** (0.02)	0.06** (0.03)	0.05** (0.02)	0.04* (0.02)	0.06** (0.02)	0.05** (0.02)
impatience	-0.00 (0.02)	-0.01 (0.02)	-0.02* (0.01)	0.00 (0.02)	-0.01 (0.02)	-0.03* (0.01)
confidence	0.02 (0.02)	0.01 (0.02)	0.04*** (0.01)	0.02 (0.02)	0.02 (0.02)	0.04*** (0.01)
risk-taking	-0.07 (0.05)	-0.06 (0.05)	-0.05 (0.04)	-0.08* (0.04)	-0.07 (0.04)	-0.05 (0.04)
age	0.00 (0.01)	-0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)
gender: male	-0.26** (0.12)	-0.21* (0.12)	-0.13 (0.08)	-0.25** (0.12)	-0.22** (0.11)	-0.13 (0.08)
business/economics at university: yes	-0.36** (0.14)	-0.40*** (0.15)	-0.20** (0.09)	-0.32** (0.13)	-0.34*** (0.13)	-0.20** (0.09)
education: Post graduate	0.27 (0.18)	0.31 (0.19)	0.34** (0.15)	0.21 (0.17)	0.29* (0.17)	0.35** (0.15)
education: University graduate	0.37 (0.22)	0.38* (0.21)	0.32** (0.15)	0.25 (0.19)	0.29 (0.18)	0.33** (0.15)
education: University student	0.26 (0.23)	0.20 (0.21)	0.23 (0.15)	0.18 (0.20)	0.17 (0.18)	0.23 (0.15)
geographic region: Germanic	-0.43 (0.29)	-0.05 (0.19)	0.07 (0.14)	-0.44 (0.28)	0.04 (0.16)	0.06 (0.14)
geographic region: Latin Europe	-0.13 (0.17)	0.24 (0.21)	0.25 (0.16)	-0.02 (0.14)	0.26 (0.18)	0.25 (0.16)
religion: Muslim	-0.09 (0.16)	-0.10 (0.19)	-0.23* (0.13)	-0.08 (0.15)	-0.10 (0.17)	-0.24* (0.13)
religion: Other	0.04 (0.14)	0.07 (0.15)	0.18* (0.11)	0.07 (0.12)	0.11 (0.13)	0.18 (0.11)
household income: 2000-3999	0.07 (0.15)	0.14 (0.18)	0.15 (0.10)	0.00 (0.13)	0.03 (0.14)	0.16 (0.10)
household income: 500-1000	-0.31* (0.17)	-0.13 (0.18)	-0.19* (0.11)	-0.39*** (0.14)	-0.26* (0.14)	-0.17 (0.11)
household income: less than 500	-0.12 (0.25)	0.05 (0.26)	-0.23 (0.16)	-0.27 (0.20)	-0.17 (0.18)	-0.21 (0.16)
household income: more than 4000	-0.07 (0.20)	-0.04 (0.22)	0.11 (0.12)	-0.12 (0.18)	-0.11 (0.19)	0.12 (0.12)
marital status: Other	-0.12 (0.29)	-0.00 (0.29)	0.08 (0.21)	-0.17 (0.29)	-0.03 (0.25)	0.09 (0.21)
marital status: Single	0.07 (0.15)	0.05 (0.16)	0.21* (0.11)	0.10 (0.13)	0.11 (0.13)	0.20* (0.11)
Criterion function	379.01			592.92		
R ²		0.10	0.25		0.16	0.24
Adj. R ²		0.05	0.20		0.11	0.20
Num. obs.	600	600	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We apply country fixed effects to the OLS regressions

We get similar results after removing our sub-samples one at a time

Standard error are between parentheses

Table 4.11: Diagnostics for IV Regression and GMM in table 4.10 using punctual debt payment as a dependent variable

Diagnostics for IV regression using financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (financial literacy)	8	560	2.166	2.84e-02**
Weak instruments (numeracy)	8	560	1.757	8.28e-02*
Wu-Hausman	2	564	4.795	8.62e-03***
Sargan	6	NA	1.439	0.96345
Diagnostics for GMM using financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
Test E(g)=0:			J-test	p-value
			2.43962	0.87516
Instrumented: financial literacy, numeracy Instruments: need for cognition, mother education, language proficiency				
Diagnostics for IV regression using cumulative financial literacy as an independent variable				
	df1	df2	statistic	p-value
Weak instruments (cumulative financial literacy)	7	560	1.873	7.17e-02*
Wu-Hausman	1	565	4.401	3.64e-02**
Sargan	6	NA	4.432	0.6185
Diagnostics for GMM using cumulative financial literacy as an independent variable				
J-Test: degrees of freedom is 6				
Test E(g)=0:			J-test	p-value
			3.4244	0.7540
Instrumented: cumulative financial literacy Instruments: need for cognition, mother education				

In our second algorithm which is Random Forest, we average out 500 trees using the Mean Squared Error with a maximum tree splits of 4. The results in table 4.12 show that the most important predictors of our proxy for punctual debt payment are family ties, financial socialization, confidence, household income, financial literacy, impatience, religion, risk-taking, numeracy, geographic region, religiosity, age, education, studied business/economics at university, gender and marital status. The results show that the main predictors of paying on time are financial literacy and socialization, cultural and psychological traits and is consistent with our Regression Trees result.

Table 4.12: Random Forest independent variable importance for punctual debt payment

Independent variable	Inc.MSE
family ties	0.113
financial socialization	0.079
confidence	0.028
household income	0.024
financial literacy	0.021
impatience	0.020
religion	0.020
risk	0.012
numeracy	0.011
geographic region	0.011
religiosity	0.008
age	0.007
education	0.005
business/economics at university	0.003
gender	0.0001
marital status	-0.0004

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the selected minimum number of splits is 4. The number of trees is 500. The R squared for this Random Forest is 22.7% and the mean squared error is 0.87. The predictability shows an R squared of 31.1% and the MSE is 0.82. Another Random Forest using another proxy for financial literacy that combines numeracy shows similar results.

Finally, our third machine algorithm is Quantile Regression Forests. The results show that at the 50th quantile, the most important predictors of punctual debt payment are family ties, household income, financial socialization, religion, financial literacy, impatience, geographic location and confidence. The results comply with the previous two machine learning algorithm and add robustness to our results. Our results of all our Quantile Regression Forests are presented in table 4.13.

We also run the three machine learning algorithms using cumulative financial literacy and the results are similar and presented in table 4.13.

Table 4.13: Summary of the three machine learning algorithms using punctual debt payment as a dependent variable

Dependent Variable: Punctual Debt Payment						
Rank	Using Financial Literacy as an Independent Variable			Using Cumulative Financial Literacy as an Independent Variable		
	Random Forest	Regression Trees	Quantile Regression Forests	Random Forest	Regression Trees	Quantile Regression Forests
1	family ties	family ties	family ties	family ties	family ties	family ties
2	financial socialization	confidence	financial socialization	financial socialization	cumulative financial literacy	financial socialization
3	confidence	age	confidence	cumulative financial literacy	age	household income
4	household income	financial socialization	household income	confidence	impatience	religion
5	financial literacy	religiosity	religion	household income	financial socialization	impatience
6	impatience	risk-taking	impatience	religion	household income	cumulative financial literacy
7	religion	financial literacy	financial literacy	impatience	confidence	geographic region
8	risk-taking	numeracy	religiosity	geographic region	risk-taking	confidence
9	numeracy	impatience	geographic region	age	geographic region	age
10	geographic region	household income	risk-taking	education	religiosity	education
11	religiosity	education	age	business/economics at university	education	risk-taking
12	age	geographic region	numeracy	religiosity	religion	religiosity
MSE/Error Rate	0.87	1.25	1.39	0.82	0.97	1.65

To conclude, the results regarding our third proxy for financial behavior which is punctual debt payment, we find that financial literacy, numeracy, confidence, family ties, financial socialization by parents, household income, Germanic individuals and religiosity have a positive influence on punctual debt payment. In addition, impatience and risk have a negative effect on punctual debt payment. We also find that the main predictors of punctual debt payment are family ties, financial socialization, financial literacy, impatience, household income, religion, geographic location and confidence. The findings that financial literacy and socialization are not the only pillars for improving punctual debt payment can contribute to the literature on financial literacy and provide insight on improving financial behavior.

4.5.4 Stock Market Participation

In previous findings, a higher level of financial literacy is associated with stock market participation. In this section, we present cultural and psychological traits that can also influence stock market participation.

We start our analysis with Probit and IV Probit regressions are presented in tables 4.14 and C.8. Our dependent variable is a binary variable with 1 being active in stock market and 0 being inactive in stock market. The endogenous variables are numeracy and financial literacy and the instruments are mother's education, need for cognition and language proficiency. The IV Probit diagnostics show that the instruments are valid.

In the Probit regressions with country fixed effect and IV Probit, financial literacy is positively associated with stock market participation. After applying need for cognition and mother's education and language proficiency as instruments for financial literacy and numeracy, we find that stock market participation increases with financial literacy and the result is statistically non-significant in the IV Probit. This result is in line with the previous empirical findings. The J-test shows that the chosen instruments for financial literacy are invalid instruments. On the other hand, numeracy is positively associated with stock market participation and the result is statistically non-significant. Financial socialization is positively associated with stock market participation and the results are also not significant. The results of financial literacy, financial socialization and numeracy in our study are similar to the previous empirical works related to finding the determinants of financial behavior.

Table 4.14: Results using stock market participation as a proxy for financial behavior

Dependent variable: stock market participation	Financial Literacy		Cumulative Financial Literacy	
	PROBIT	IVPROB	PROBIT	IVPROB
financial literacy	0.07 (0.05)	0.08 (0.05)		
cumulative financial literacy			-0.03 (0.03)	-0.02 (0.03)
numeracy	0.04 (0.07)	0.03 (0.07)		
financial socialization	0.01 (0.03)	0.02 (0.03)	0.01 (0.03)	0.01 (0.03)
family ties	-0.04 (0.03)	-0.04 (0.03)	-0.04 (0.03)	-0.04 (0.03)
religiosity	-0.06* (0.03)	-0.05* (0.03)	-0.06* (0.03)	-0.06* (0.03)
impatience	-0.05* (0.02)	-0.05** (0.02)	-0.06** (0.02)	-0.05** (0.02)
confidence	0.00 (0.02)	0.00 (0.02)	0.01 (0.02)	0.01 (0.02)
risk-taking	0.17*** (0.06)	0.17*** (0.06)	0.18*** (0.06)	0.18*** (0.06)
age	0.02* (0.01)	0.02* (0.01)	0.02* (0.01)	0.02* (0.01)
gender: male	0.32** (0.13)	0.32** (0.13)	0.35*** (0.13)	0.34*** (0.13)
business/economics at university: yes	0.27* (0.15)	0.26* (0.15)	0.30** (0.15)	0.29* (0.15)
education: Post graduate	-0.13 (0.24)	-0.11 (0.24)	-0.07 (0.24)	-0.08 (0.24)
education: University graduate	-0.24 (0.25)	-0.23 (0.25)	-0.20 (0.25)	-0.20 (0.25)
education: University student	-0.15 (0.26)	-0.14 (0.26)	-0.11 (0.26)	-0.12 (0.26)
geographic region: Germanic	-0.10 (0.22)	-0.10 (0.22)	0.02 (0.23)	-0.00 (0.23)
geographic region: Latin Europe	-0.12 (0.22)	-0.11 (0.22)	-0.15 (0.22)	-0.15 (0.22)
religion: Muslim	-0.32 (0.21)	-0.32 (0.21)	-0.36* (0.21)	-0.36* (0.21)
religion: Other	-0.09 (0.18)	-0.08 (0.18)	-0.08 (0.17)	-0.09 (0.17)
household income: 2000-3999	0.24 (0.17)	0.24 (0.17)	0.28* (0.17)	0.28* (0.17)
household income: 500-1000	-0.03 (0.20)	-0.03 (0.20)	0.01 (0.20)	0.00 (0.20)
household income: less than 500	0.21 (0.27)	0.21 (0.27)	0.24 (0.26)	0.24 (0.26)
household income: more than 4000	0.34* (0.19)	0.33* (0.19)	0.41** (0.19)	0.40** (0.19)
marital status: Other	0.02 (0.35)	0.01 (0.35)	0.07 (0.35)	0.06 (0.35)
marital status: Single	-0.17 (0.18)	-0.17 (0.18)	-0.16 (0.18)	-0.16 (0.18)
AIC	616.79	616.17	616.34	616.87
BIC	726.71	726.10	721.87	722.39
Log Likelihood	-283.39	-283.09	-284.17	-284.43
Deviance	566.79	566.17	568.34	568.87
Num. obs.	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We get similar results after removing our sub-samples one at a time

Standard errors are between parentheses

1st stage F-statistic: 6.743 on 7 and 592 DF, p-value: 1.045e-07

overidentification test: p-value: 0.00

In addition, family ties have a negative and statistically non-significant coefficient, that is, as family ties rise, stock participation decreases. This is an interesting result which shows that individuals with family ties rely on other sources of investments instead of stock market participation. Religiosity is also negatively associated with stock market participation and the result is significant. We can find that individuals with family ties and religiosity tend to be more risk averse in their financial investments.

Impatience shows a significant and negative coefficient and confidence shows no effect on stock market participation. Moreover, risk-taking is positively associated with stock market participation and the result is significant. As opposed to our results, confidence shows a positive effect on stock market participation in previous empirical works.

Also, age, males and business/economics at the university are positively associated with stock participation. To conclude, we find that stock market participation is associated with financial literacy, age, gender, risk-taking and studying business/economics at the university.

We also repeat the regressions using another proxy for financial literacy which includes numeracy. The R squared of this model is lower and the results are similar to our findings. The results using the second proxy for financial literacy are also presented in table 4.14.

We then run PCR using 10 components as suggested by the parallel analysis in figure 4.5. The PCR results are presented in the fourth column of tables 4.20 and 4.21. We find that stock market participation is associated with financial literacy, numeracy, age, risk-taking and financial socialization by parents.

We also run Classification Trees, Random Forest and Quantile Regression Forests for our fourth dependent variable which is stock participation which is a binary variable. The Classification Trees results show that the most important drivers of stock participation are family ties, financial socialization, age, geographic location, confidence, religiosity, household income, financial literacy and gender. The results comply with our Probit regressions and PCR. The results of all our Classification Trees are presented in table 4.16.

In our second machine learning algorithm, we use a more accurate algorithm that adds robustness to the Classifica-

tion Trees. We average out 500 trees using incremental mean squared error at a maximum tree splits of 4. The results in table 4.15 show that the main predictors of stock participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business/economics at university and financial socialization. This shows that individuals with stronger family ties and religiosity are less likely to participate in the stock market. This finding can be very useful in constructing financial literacy programs that can aim to improve individual financial behavior.

Table 4.15: Random Forest independent variable importance for stock participation

Independent variable	Inc.MSE
age	0.007
religiosity	0.006
gender	0.006
family ties	0.006
religion	0.006
financial literacy	0.005
geographic region	0.005
household income	0.005
impatience	0.004
confidence	0.004
education	0.004
marital status	0.003
numeracy	0.003
risk	0.002
business/economics at university	0.002
financial socialization	0.001

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the selected minimum number of splits is 4. The number of trees is 500. The error rate of the classification is 16%. The predictability shows an error rate of 23%. Another Random Forest using another proxy for financial literacy that combines numeracy shows similar results.

Finally, our Quantile Regression Forests show that at the 50th quantile, the main predictors of stock participation are age, religiosity, family ties, household income, education, geographical location, financial socialization, confidence, impatience and gender. The results of all our Quantile Regression Forests are presented in table 4.16.

We also run the three machine learning algorithms using cumulative financial literacy and the results are similar and presented in table 4.16.

Table 4.16: Summary of the three machine learning algorithms using stock market participation as a dependent variable

Dependent Variable: Stock Market Participation						
Rank	Using Financial Literacy as an Independent Variable			Using Cumulative Financial Literacy as an Independent Variable		
	Random Forest	Classification Trees	Quantile Regression Forests	Random Forest	Classification Trees	Quantile Regression Forests
1	age	confidence	family ties	gender	family ties	age
2	religiosity	family ties	geographic region	geographic region	age	family ties
3	gender	financial socialization	confidence	age	impatience	geographic region
4	family ties	age	financial socialization	household income	education	education
5	religion	religion	religiosity	religiosity	confidence	household income
6	financial literacy	religiosity	household income	family ties	financial socialization	religiosity
7	geographic region	risk-taking	age	religion	geographic region	gender
8	household income	impatience	religion	education	household income	financial socialization
9	impatience	household income	gender	impatience	cumulative financial literacy	confidence
10	confidence	geographic region	impatience	marital status	religiosity	impatience
11	education	financial literacy	business/economics at university	business/economics at university	gender	religion
12	marital status	education	marital status	financial socialization	risk-taking	business/economics at university
MSE/Error Rate	23%	22.5%	20%	25.8%	26.6%	25.8%

To conclude, the regressions find that stock participation is associated with males, age, financial literacy, numeracy, weak family ties, financial socialization by parents, education and household income. In the regressions, financial literacy, risk-taking, age, Germanic individuals, household income and males are positively associated with stock market participation. Also, family ties, religiosity and impatience are negatively associated with stock market participation. Using Random Forests, the most important drivers of stock market participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business/economics at university and financial socialization. The results are consistent with findings in the literature but our findings show that family ties, religiosity and impatience are negatively associated with stock market participation.

4.5.5 Saving for Retirement

Our last dependent variable included in our study is saving for retirement. This is a binary variable where one stands for an individual knowing how much savings are needed for retirement and zero stands for not knowing. We run a Probit and IV Probit regressions. The endogenous variables are financial literacy and numeracy. The instruments are need for cognition, language proficiency and mother's education. The IV Probit diagnostics show that the selected instruments are invalid. The Probit results using saving for retirement as a dependent variable are presented in tables 4.17 and C.7.

The Probit and IV Probit regressions are available in table 4.17. The results show that financial socialization, confidence (significant), risk-taking and age are positively associated with saving for retirement. Also, family ties, impatience (significant), numeracy and religiosity are negatively associated with saving for retirement and the results are also not significant. Using this proxy for financial behavior, financial literacy and numeracy do not show a positive influence. This

Table 4.17: Results using retirement saving as a proxy for financial behavior

	Financial Literacy		Cumulative Financial Literacy	
	PROBIT	IVPROB	PROBIT	IVPROB
financial literacy	0.00 (0.05)	0.01 (0.05)		
cumulative financial literacy			-0.01 (0.03)	-0.07 (0.05)
numeracy	-0.08 (0.06)	-0.08 (0.06)		
financial socialization	0.01 (0.03)	0.01 (0.03)	0.01 (0.03)	0.02 (0.05)
family ties	-0.05* (0.03)	-0.05* (0.03)	-0.05* (0.03)	-0.08 (0.05)
religiosity	-0.02 (0.03)	-0.02 (0.03)	-0.03 (0.03)	-0.04 (0.05)
impatience	-0.07*** (0.02)	-0.07*** (0.02)	-0.07*** (0.02)	-0.13*** (0.04)
confidence	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.12*** (0.03)
risk-taking	0.00 (0.06)	0.00 (0.06)	-0.00 (0.06)	-0.01 (0.10)
age	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.02)
gender: male	0.11 (0.13)	0.11 (0.13)	0.12 (0.13)	0.23 (0.22)
business/economics at university: yes	-0.00 (0.14)	-0.01 (0.14)	-0.00 (0.15)	0.03 (0.25)
education: Post graduate	-0.18 (0.24)	-0.19 (0.24)	-0.19 (0.24)	-0.28 (0.41)
education: University graduate	-0.19 (0.25)	-0.20 (0.25)	-0.18 (0.25)	-0.28 (0.43)
education: University student	-0.23 (0.26)	-0.24 (0.26)	-0.22 (0.26)	-0.38 (0.45)
geographic region: Germanic	-0.57** (0.22)	-0.58*** (0.22)	-0.57** (0.22)	-0.87** (0.38)
geographic region: Latin Europe	-0.82*** (0.22)	-0.82*** (0.22)	-0.80*** (0.22)	-1.34*** (0.38)
religion: Muslim	-0.02 (0.20)	-0.01 (0.20)	-0.01 (0.20)	-0.07 (0.34)
religion: Other	0.07 (0.19)	0.07 (0.18)	0.06 (0.18)	0.11 (0.32)
household income: 2000-3999	0.14 (0.17)	0.13 (0.17)	0.15 (0.16)	0.26 (0.28)
household income: 500-1000	-0.02 (0.19)	-0.02 (0.19)	-0.01 (0.19)	-0.01 (0.33)
household income: less than 500	0.39 (0.25)	0.39 (0.25)	0.37 (0.25)	0.63 (0.41)
household income: more than 4000	0.32* (0.19)	0.31* (0.19)	0.33* (0.19)	0.58* (0.32)
marital status: Other	0.09 (0.32)	0.09 (0.32)	0.06 (0.32)	0.16 (0.52)
marital status: Single	-0.46*** (0.16)	-0.46*** (0.16)	-0.46*** (0.16)	-0.75*** (0.28)
AIC	665.29	665.25	664.69	664.32
BIC	775.22	775.18	770.21	769.84
Log Likelihood	-307.65	-307.63	-308.34	-308.16
Deviance	615.29	615.25	616.69	616.32
Num. obs.	600	600	600	600

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

We get similar results after removing our sub-samples one at a time

Standard errors are between parentheses

1st stage F-statistic: 6.743 on 7 and 592 DF, p-value: 1.045e-07

overidentification test: p-value: 0.00

result is not in line with previous studies which may be attributed to the use of cultural and psychological variables that can have a stronger impact on financial behavior. Based on the evidence of our study, we can infer that individuals with strong family ties and religiosity rely on other sources of income for retirement such as inheritance or family support, which can be an area of study for future research. Also, based on our findings, financial literacy appears to have no effect on retirement saving as the result is statistically non-significant. Confidence is significant and positively associated with saving for retirement. Married individuals save more for retirement and the result is significant. In addition, impatience is negatively associated with saving for retirement and the result is significant.

We also repeat the regressions using another proxy for financial literacy which includes numeracy. The R squared of this model is lower and the results are similar to our findings. The results using the second proxy for financial literacy are also presented in table 4.17. The Principal Component Regressions are presented in tables 4.20 and 4.21 and show similar results to the Probit regressions.

The result of our first machine learning algorithm which is Classification Trees shows that the strongest predictors of savings for retirement are family ties, confidence, age, financial socialization, impatience, religion, education, religiosity and marital status. The results of our Classification Trees are presented in table 4.19.

The result of our second machine learning algorithm, which is Random Forest as shown in table 4.18, shows that the main predictors of saving for retirement are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity.

Finally, our Quantile Regression Forests result show that the strongest predictors of savings for retirement are confidence, age, marital status, religion, financial socialization, geographic location, family ties and impatience. The importance of marital status is associated with data that shows that married individuals care more about retirement savings compared with single individuals. The results of all our Quantile Regression Forests are presented in table 4.19.

We also run the three machine learning algorithms using cumulative financial literacy and the results are similar and presented in table 4.19.

Table 4.18: Random Forest for independent variable importance for retirement savings

Independent variable	Inc.MSE
confidence	0.020
marital status	0.008
geographic_region	0.007
family ties	0.005
impatience	0.005
age	0.005
education	0.004
religion	0.003
financial literacy	0.003
financial socialization	0.002
numeracy	0.002
risk	0.002
gender	0.002
household income	0.001
business/economics at university	0.001
religiosity	-0.002

Note: We apply an unconditional mean decrease in accuracy using the Breiman approach. After pruning the data, the selected minimum number of splits is 4. The number of trees is 500. The classification error is 16.24%. The predictability shows an error of 24.1%. Another Random Forest using another proxy for financial literacy that combines numeracy shows similar results.

Table 4.19: Summary of the three machine learning algorithms using retirement saving as a dependent variable

Dependent Variable: Retirement Saving						
Rank	Using Financial Literacy as an Independent Variable			Using Cumulative Financial Literacy as an Independent Variable		
	Random Forest	Classification Trees	Quantile Regression Forests	Random Forest	Classification Trees	Quantile Regression Forests
1	confidence	family ties	confidence	confidence	age	confidence
2	marital status	confidence	geographic region	marital status	confidence	age
3	geographic region	age	financial socialization	impatience	financial socialization	marital status
4	family ties	religion	marital status	geographic region	family ties	financial socialization
5	impatience	impatience	family ties	family ties	household income	education
6	age	religiosity	age	financial socialization	religion	family ties
7	education	financial socialization	religion	education	geographic region	impatience
8	religion	marital status	financial literacy	gender	religiosity	religion
9	financial literacy	education	household income	business/economics at university	education	geographic region
10	financial socialization	geographic region	impatience	age	impatience	risk-taking
11	numeracy	financial literacy	risk-taking	cumulative financial literacy	cumulative financial literacy	cumulative financial literacy
12	risk-taking	numeracy	numeracy	household income	marital status	household income
MSE/Error Rate	24.1%	28.3%	25%	24.16%	25.8%	20.8%

To conclude, in the regressions, saving for retirement is positively associated with confidence, financial socialization, married individuals, age, Muslims and Arabs. In addition, saving for retirement is negatively associated with family ties, religiosity, numeracy and impatience. Based on our results, financial literacy has no effect on retirement saving. Using Random Forest algorithm, the most important drivers of retirement saving are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity. Individuals with strong family ties and religiosity may rely on other sources for retirement savings such as inheritance.

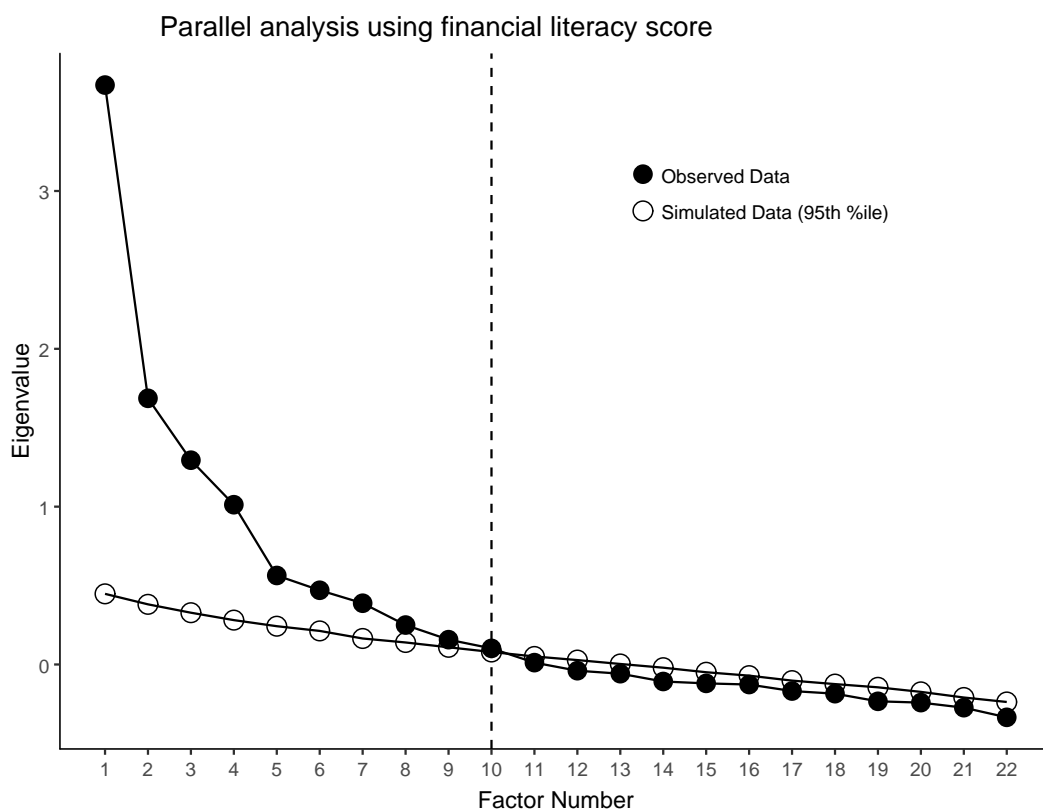


Figure 4.5: Parallel analysis scree plot of our PCA for financial behavior using financial literacy as an independent variable

Table 4.20: Principal Component Regression coefficients of the selected 5 dependent variables

Independent Variable	Active Saving	Budgeting	Punctual Debt Behavior	Stock Participation	Retirement Saving
financial_socialization_1	0.226	0.198	0.087	0.009	-0.015
financial_socialization_2	0.243	0.216	0.095	0.017	-0.029
risk-taking	0.035	0.030	-0.042	0.144	0.016
religiosity_1	0.072	0.060	-0.016	-0.018	0.035
religiosity_2	0.045	0.027	0.019	-0.088	0.004
confidence_1	0.039	0.013	0.034	-0.020	0.033
confidence_2	0.001	-0.006	0.010	0.001	0.073
confidence_3	0.033	0.045	0.023	0.068	0.115
confidence_4	0.008	0.004	0.002	0.022	0.100
confidence_5	0.081	0.080	0.047	0.057	0.082
impatience_1	-0.160	-0.118	-0.006	-0.053	-0.042
impatience_2	-0.168	-0.145	-0.069	-0.039	-0.005
impatience_3	-0.181	-0.144	-0.041	-0.054	-0.068
impatience_4	0.038	-0.006	0.056	-0.084	-0.130
family_ties_1	0.051	0.028	0.174	-0.162	-0.098
family_ties_2	0.021	-0.005	0.051	-0.021	-0.006
family_ties_3	-0.052	-0.030	0.090	-0.122	-0.085
numeracy	-0.009	0.060	0.157	-0.004	-0.088
financial literacy	-0.034	0.013	0.048	0.035	-0.071
age	-0.049	0.021	0.016	0.200	0.108

Note: We run a principal component regression of the 5 dependent variables against 10 principal components as suggested by the parallel analysis.

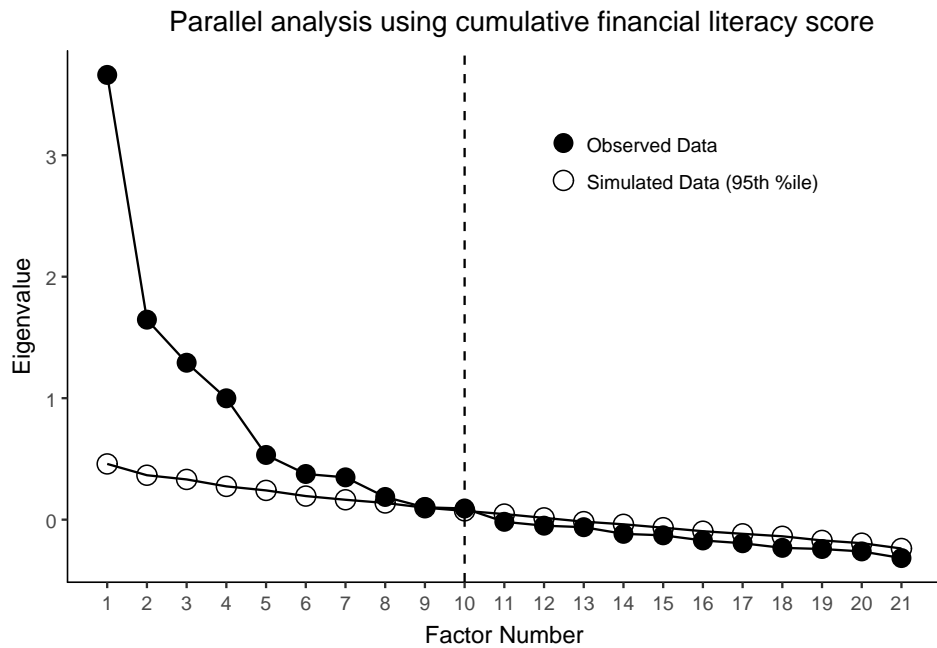


Figure 4.6: Parallel analysis scree plot of our PCA for financial behavior using cumulative financial literacy as an independent variable

Table 4.21: Principal Component Regression coefficients of the 5 dependent variables using cumulative financial literacy as an independent variable

Independent Variable	Active Saving	Budgeting	Punctual Debt Behavior	Stock Participation	Retirement Saving
financial_socialization_1	0.220	0.197	0.076	-0.003	-0.020
financial_socialization_2	0.240	0.218	0.103	0.011	-0.036
risk	0.022	0.031	-0.051	0.135	0.001
religiosity_1	0.075	0.059	-0.017	-0.012	0.039
religiosity_2	0.053	0.027	0.025	-0.075	0.014
confidence_1	0.035	0.013	0.035	-0.028	0.027
confidence_2	0.001	-0.007	0.007	-0.003	0.073
confidence_3	0.039	0.047	0.035	0.071	0.118
confidence_4	0.009	0.003	0.000	0.019	0.101
confidence_5	0.086	0.078	0.043	0.063	0.090
impatience_1	-0.164	-0.117	-0.006	-0.053	-0.048
impatience_2	-0.172	-0.147	-0.077	-0.049	-0.007
impatience_3	-0.187	-0.146	-0.047	-0.058	-0.075
impatience_4	0.049	-0.009	0.058	-0.079	-0.114
family_ties_1	0.064	0.032	0.197	-0.138	-0.090
family_ties_2	0.017	-0.007	0.041	-0.033	-0.008
family_ties_3	-0.032	-0.026	0.123	-0.093	-0.069
cumulative financial literacy	-0.018	0.040	0.164	0.056	-0.103
age	-0.030	0.044	0.038	0.222	0.124

Note: We run a principal component regression of the 5 dependent variables against 10 principal components as suggested by the parallel analysis.

Table 4.22: Summary of the regression results

Independent Variable	Active Saving	Budgeting	Punctual Debt Payment	Saving for retirement	Stock Participation
financial Literacy	-	+***	+	X	+
numeracy	-	+	+**	-	+
financial socialization	+***	+***	+***	+	+
family ties	+	+	+***	-	-
religiosity	+	+***	+**	-	-
impatience	-.***	-.***	X	-.***	-.**
confidence	+***	+	+	+***	X
risk-taking	+	-	-	X	+***
age	+	+	X	+	+**

Note:+ is for positively correlated, - is for negatively correlated, x is for uncorrelated, * is for statistically significant at 10%, ** is statistically significant at 5% and *** is for statistically significant at 1%.

Table 4.23: Summary of the regression analysis using cumulative financial literacy

Independent Variable	Active Saving	Budgeting	Punctual Debt Payment	Saving for retirement	Stock Participation
cumulative financial literacy	-.***	+**	+**	-	X
financial socialization	+***	+***	+***	+	+
family ties	+*	-	+***	-	-
religiosity	+	+***	+*	-	-.*
impatience	-.***	-.***	X	-.***	-.***
confidence	+**	+	+	+***	X
risk	+*	X	-.*	X	+***
age	+	+	X	+	+**

Note:+ is for positively correlated, - is for negatively correlated, x is for uncorrelated, * is for statistically significant at 10%, ** is statistically significant at 5% and *** is for statistically significant at 1%.

Table 4.24: Summary of the Random Forest rank of the independent variables by importance in influencing our proxies of financial behavior

Rank	Active Saving	Budgeting	Paying on Time	Saving for Retirement	Stock Participation
1	impatience	impatience	family ties	confidence	age
2	financial socialization	financial socialization	financial socialization	marital status	religiosity
3	confidence	geographic region	confidence	geographic region	gender
4	gender	confidence	household income	family ties	family ties
5	religiosity	religiosity	financial literacy	impatience	religion
6	geographic region	business/economics at university	impatience	age	financial literacy
7	family Ties	risk-taking	religion	education	geographic region
8	age	gender	risk-taking	religion	household income
9	religion	education	numeracy	financial literacy	impatience
10	risk-taking	religion	geographic region	financial socialization	confidence
11	household income	numeracy	religiosity	numeracy	education
12	education	family ties	age	risk-taking	marital status
MSE/Error Rate	1.39	1.48	0.82	24.1%	23%

4.6 Conclusion and Recommendations

Studies show that higher levels of financial literacy are associated with better financial behavior. However, financial literacy is subject to the endogeneity problem which makes the true effect of financial literacy unobservable. The three main causes of endogeneity are omitted variable bias, measurement error and reverse causality. To control for omitted variable bias, we consider demographic, socioeconomic, psychological and cultural factors as determinants of our five proxies of financial behavior. Our first contribution controls for the omitted variable bias by including cultural factors which are family ties and religiosity for the first time in a financial literacy study. To control for the financial literacy measurement error, we use two proxy measures of financial literacy where the first proxy is Lusardi and Mitchell (2011c) 's "big three" financial literacy questions which address interest rates, inflation and diversification. We use another proxy for financial literacy which combines the "big three" questions with three numeracy questions. We chose to include numeracy questions due to evidence of a significant effect of numeracy on financial behavior measures. In addition, to control for reverse causality, our contribution lies in the comparative aspect of our sample selection in which we select Germanic, Arabic and Latin European sub samples to compare the determinants of financial behavior measures across different regions. Another way to control for endogeneity in financial literacy is using instrumental variables in our regression analysis. We use mother's education, math skills at the age of 10 and need for cognition as instruments for financial literacy. Applying Regression Trees, Random Forests and Quantile Regression Forests can be suitable for cross-financial literacy studies due to their ability to predict the most important drivers of financial behavior.

We validate our empirical model with micro-economic data. We use a cross regional survey collected across Arabic, Germanic and Latin European countries. Our dependent variable consists of five proxy measures of financial behavior which are active saving, budgeting, punctual debt payment, stock market participation and retirement savings, and our independent variables are two proxies of financial literacy, financial socialization by parents, numeracy, family ties, religiosity, impatience, confidence, risk-taking and a vector of demographics.

We conduct our analysis for every dependent variable proxy. We apply OLS regressions with fixed effects, IV regressions, GMM, PCA and PCR. In our IV regression and GMM, our endogenous variables are numeracy and financial literacy. Our instruments are math skills at 10, need for cognition, mother's education and language proficiency. The IV regressions and diagnostics show the validity of our selected instruments.

We also apply AI techniques for the first time in financial literacy studies. The applied algorithms consist of Regression Trees and Random Forest analysis. These techniques can help identify the most important variables that describe financial behavior.

In finding our determinants of active saving which is our first proxy of financial behavior, our results are consistent throughout the different techniques applied and show that psychological factors and cultural traits are the main determinants and predictors of active saving. As opposed to previous findings, financial literacy and numeracy show weak effects on active saving.

In the regressions, family ties, religiosity, confidence, risk-taking, education, Germanic individuals, household income and females are positively attributed to active saving. Also, impatience is negatively associated with active saving. Using the Random Forest algorithm, we find that the main predictors of active saving are impatience, financial socialization, confidence, gender, religiosity, geographic region, family ties, age, religion, risk-taking, household income, education, financial literacy, studied business/economics at university, marital status and numeracy.

In our study, financial socialization by parents is the most important driver of active saving which can be applied to the implementation of financial education programs. That is, educating parents on the importance of financially socializing with their children is a good tool for improving financial behavior. Moreover, the importance of psychological factors on financial behavior highlights the importance of promoting psychological health recognizing the linkages between mental health and financial behavior.

We run the same regressions using our second proxy for financial literacy and the results are consistent with our findings. However, the R squared of our regression model using our first proxy of financial literacy is higher. The same result applies to the remaining regressions using our other proxies of financial behavior.

In our second proxy of financial behavior which is budgeting, we find that using our different empirical approaches, financial literacy, numeracy, financial socialization, Latin Europeans, religiosity, Muslims and confidence have a positive effect on budgeting. In addition, impatience and males are negatively associated with budgeting. Using three machine

learning algorithms, we find that the main drivers of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status. Impatience happens to be an important determinant of budgeting. As psychological traits such as impatience are hard to control for in financial education programs, more public policies aimed at protecting and improving the financial well-being of individuals may be needed.

To conclude, the results regarding our third proxy of financial behavior which is punctual debt payment, we find that financial literacy, numeracy, confidence, family ties, financial socialization by parents, household income, Germanic individuals and religiosity have a positive influence on punctual debt payment. In addition, impatience and risk have a negative effect on punctual debt payment. We also find that the main predictors of punctual debt payment are family ties, financial socialization, confidence, household income, financial literacy, impatience, religion, risk-taking, numeracy, geographic region, religiosity, age, education, studied business economics at university, gender and marital status. The importance of family ties in affecting debt behavior can help researchers and policy makers implement special financial education programs that are culturally adjusted based on the country's strength of family ties.

Concerning our fourth proxy of financial behavior which is stock market participation, we find that stock market participation is associated with males, age, financial literacy, numeracy, financial socialization by parents, education and household income. The results are consistent with the findings in the literature and our new findings show that family ties and religiosity are negatively associated with stock market participation. In the regressions, financial literacy, financial socialization by parents, numeracy, risk-taking, age, Germanic individuals, household income and males are positively associated with stock market participation. Moreover, family ties, religiosity and impatience are negatively associated with stock market participation. Using Random Forests, the most important drivers of stock market participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business economics at university and financial socialization. We suggest that financial education be designed to target different demographic groups to improve individual stock market participation.

Our last proxy measure of financial behavior is saving for retirement and it is associated with marital status, confidence and age. In addition, saving for retirement is negatively associated with family ties, religiosity and impatience. In

the regressions, saving for retirement is positively associated with confidence, financial socialization, married individuals, age, Muslims and Arabs. In addition, saving for retirement is negatively associated with family ties, religiosity and impatience. In the regressions, financial literacy has no effect on retirement saving. Using Random Forest algorithm, the most important drivers of retirement saving are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity.

We conclude that individuals with strong family ties and religiosity may rely on other sources for retirement savings such as inheritance or family support. In addition, married individuals save more for retirement compared with single individuals and suggests that married couples take saving for retirement more seriously than single individuals.

Even though financial literacy and financial socialization show to be positively associated with financial behavior, it is apparent that cultural factors such as religiosity and family ties, and psychological factors such as risk-taking, confidence and impatience are also main drivers of financial behavior. Based on these findings, we propose that changes be made regarding the construction of financial education programs in their effect on financial behavior. Relying solely on educating individuals with financial concepts does not sufficiently address financial behavior. In fact, taking cultural and psychological differences of individuals into account in financial education programs can improve the quality of financial education and its aim to improve financial behavior. These findings suggest that there is a need for implementing financial education programs based on individual cultural and psychological differences, which in turn will positively impact financial behavior.

If financial socialization remains to be the most influential determinant of financial behavior, governments can target parents in their financial education curricula. In countries with strong family ties, governments can invest in financial education programs for parents. This can make parents financially socialize with their children to improve their financial literacy and financial behavior. In addition, in religious countries, financial education program can also be integrated in places of worship by educating religious figures, who can later give incentives to improve financial literacy and financial behavior to their followers. In addition, to improve financial behavior, financial education programs can be tailored for specific individuals such as those who are impatient and lack confidence.

We recommend more research to be done with the overall aim of implementing different approaches related to financial literacy, financial socialization, cultural and psychological traits, in constructing financial education programs and public policies that can effectively improve financial behavior across different cultures and traditions.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

In this financial literacy study, we present the findings of three papers on the determinants of financial literacy and financial behavior. The first paper examines the effect of family ties on investing in financial literacy and the effect of family ties and financial literacy on four proxies of financial behavior, which are debt accumulation, savings, investment in complex financial instruments and wealth accumulation. In this paper, we start by presenting our inter-temporal choice model for investing in financial literacy. We posit that investing in financial literacy is time consuming and costly but improves the saving behavior of individuals. Also, we posit that individuals with strong family ties tend to rely on family advice regarding financial matters. This makes individuals with strong family ties consume or save more instead of investing in financial literacy. The result shows that individuals with strong family ties accumulate lower levels of financial literacy which forces them to optimally save more. On the other hand, individuals with weak family ties have higher levels of financial literacy which allows them to invest in financial instruments that produce a higher return. This makes individuals with weak family ties optimally need to save less. We test our inter-temporal model using a micro-economic data from the Survey of Health, Ageing and Retirement in Europe (SHARE WAVE 3,5 and 6). The empirical results are consistent with our theoretical model.

In the second paper, we run a cross regional study using primary data on the determinants of financial literacy. We analyze the determinants of financial literacy which are numeracy, financial socialization by parents, family ties, religiosity, confidence, impatience and a vector of demographics across three geographic regions which are Latin Europe (Spain and Portugal), the Middle East (Lebanon, Syria, Palestine and Jordan) and Germanic countries (Germany and Holland).

Our third paper runs a cross regional study to find the determinants of five proxy measures of financial behavior (savings, stock market participation, budgeting, retirement saving and punctual debt payment). We run this study using our primary data set across three geographic regions which are Latin European, Middle Eastern and Germanic countries. The results, conclusion and recommendations of the 3 papers are presented below.

5.1 Family ties and Investment in Financial Literacy

In our first paper entitled "The effect of family ties on investment in financial literacy and individual financial behavior" we update Jappelli and Padula (2013)'s inter-temporal choice model by endogenizing financial literacy through the effect of family ties. In our model, we show that individuals invest in financial literacy at a cost. We posit that the amount of investment in financial literacy of individuals is related to the individual's level of family ties. Individuals with strong family ties are less willing to invest in financial literacy because the individual can rely on family members in to make financial decisions. On the other hand, individuals with weak family ties tend to invest more in financial literacy to improve their financial decisions. Based on the assumption that a higher level of financial literacy improves an individual's financial decisions, which in turn raises their return on financial investments, the individual with strong family ties will optimally need to save more compared to those with weak family ties. Individuals with weak family ties tend to have a better command of financial literacy and optimally can save less because they will have higher return on investments due to better investment decisions.

To validate our model, we use micro-economic data from SHARE WAVES 3,5 and 6 which is a European data set across 14 European countries. In our first econometric model, we use financial literacy as the dependent variable and three proxy measures of family ties, math skills at the age of ten and a vector of demographics as independent variables. In our second econometric model, we use four proxy measures of financial behavior as dependent variables which are savings, investment in complex financial instruments such as stocks, wealth and debt accumulation. Our independent variables are financial literacy, two proxy measures of family ties and a vector of demographics. To analyze the data, we apply OLS, Instrumental Variables and GMM regressions.

In our first econometric model, we find that weak family ties have a positive correlation with financial literacy levels and strong family ties have a negative correlation with financial literacy levels. When we run a two stage least squares regression model and Generalized Method of Moments, math skills at 10 shows a consistent effect on financial literacy. Also, family ties show a significant and strong effect on an individual's financial literacy. We find that individuals with strong level of family ties acquire lower levels of financial literacy. When Spain and Italy are removed from the sample, the result remains robust.

In the remaining four econometric models, we use four proxies for financial behavior as dependent variables (saving, investment in complex instruments, wealth and debt accumulation). We find that financial literacy has a positive and significant effect on saving, investment and wealth. Also, we find that a higher level of financial literacy lowers the debt level of individuals. We also find that only strong family ties can negatively influence the saving, investments and wealth. On the contrary, at all levels, strong family ties raise the individual's level of indebtedness.

In addition, we find that OLS underestimates the effect of the financial literacy on saving, investment in complex instruments, wealth and debt accumulation. We propose an IV approach and GMM to address the endogeneity bias of family ties and financial literacy. We use verbal proficiency at the age of 10, frequency of receiving care from family members, frequency of family contact in social network and math skills at 10 as instrumental variables for financial literacy. OLS regression tends to underestimate the correlation between financial behavior proxies and financial literacy. In addition, the coefficient of strong family ties shows a negative significance in the IV regression of the financial behavior proxies. Our finding provides a strong argument for family ties to be taken into account in the design and implementation of financial education programs that aim to improve financial behavior.

Overall, our evidence identifies two important determinants of financial literacy. The micro-economic data evidence shows that improving mathematical skills early in life improves household financial literacy and saving behavior. In addition, family ties are a determinant of the current stock of an individual's financial literacy. Strong family ties are associated with lower levels of financial literacy and sub optimal financial behavior among individuals. Also, financial literacy and family ties are two important determinants of financial behavior and can play a role in the design and implementation of effective financial education programs.

The international comparison suggests that raising the incentive to invest in financial literacy may also lead to higher financial literacy and saving, keeping in mind that strong family ties can be a negative influence on investing in financial literacy. We recommend further studies that integrate family ties in financial literacy studies. A better proxy for family ties is recommended and other instruments for financial literacy and family ties are needed to provide a better evidence of the causality between family ties and financial behavior.

5.2 Determinants of Financial Literacy

In this paper, we consider demographic, socioeconomic, psychological and cultural factors as determinants of financial literacy. Our research focuses on the comparative aspect of our sample selection in which we select Germanic, Arabic and Latin European sub samples to compare the determinants of financial literacy across different regions. In addition, we select two proxies of financial literacy in which one proxy integrates numeracy as a part of financial literacy and the other does not. Choosing two proxies of financial literacy controls for the measurement error that is discussed in previous financial literacy studies. We also control for omitted variable bias by introducing psychological (confidence and impatience) and cultural factors (family ties and religiosity) as determinants of financial literacy. Moreover, we introduce AI using machine learning algorithms for the first time in a financial literacy study. Applying Regression Trees, Random Forests and Quantile Regression Forests can be suitable for cross-financial literacy studies due to their ability to find the determinants of financial literacy and rank them by importance.

We validate our empirical model with micro-economic data. We use a cross-region survey collected across Arabic, Germanic and Latin European countries. Our dependent variable is financial literacy and our independent variables are numeracy, math skills at 10, financial socialization by parents, confidence, impatience, family ties, religiosity and a vector of demographics.

We apply OLS regressions with fixed effects, IV regressions, Generalized Method of Moments, Principal Component Analysis and Principal Component Regressions. To control for the endogeneity of numeracy, we use instrumental variable regression using need for cognition, parental education and language proficiency as instruments. Our regression analysis finds that numeracy, financial socialization, math skills at the age of 10, confidence, Germanic countries, males and Christians are associated with higher levels of financial literacy. In addition, family ties and impatience have a negative influence on financial literacy. Finally, religiosity has a weak and statistically non-significant effect on financial literacy.

Applying AI techniques, the applied algorithms consist of Regression Trees and Random Forest analysis. The advantage of using these techniques is predicting the most important variables that describe financial literacy.

The results show that financial literacy is positively associated with numeracy, financial socialization by parents,

confidence and geographic location, In addition, financial literacy is negatively associated with impatience and family ties. The results also show that financial literacy is mainly described by geographic region, numeracy, household income, religion, gender and financial socialization. The results can be used to adjust and improve the implementation of financial education programs based on people's culture and habits.

If numeracy remains the most influential determinant of financial literacy, we propose that governments should emphasize and strengthen mathematics in education curricula. In parallel, if financial socialization is an important determinant of financial literacy, financial education programs can target parents emphasizing the importance of passing financial knowledge to children. Particularly, in countries with strong family ties, governments can invest in financial education programs for parents. This can make parents financially socialize with their children to improve their financial literacy and financial behavior. Moreover, in religious countries, financial education program can also be introduced in places of worship by educating religious figures. This will aim to improve the financial literacy of religious individuals. Finally, financial education programs can target specific individuals who are impatient and lack confidence. However, due to the difficulty of controlling for psychological traits in financial education programs, policies and regulations are needed to protect individuals from financial turmoils and improve their financial well-being. From this perspective, the role of financial advisers and regulators can be important. For instance, risk tolerance tests that are required for investing could address impatience and risk-taking and adjust advice to these individuals based on their individual characteristics. We believe that financial institutions may have a huge role in educating people and nudging them to better decision making.

We recommend that more research is needed on different approaches to constructing financial education programs that can be effective in improving financial behavior across different cultures and traditions.

5.3 Determinants of Financial Behavior

Studies empirically show that a higher level of financial literacy is the gateway to improving individual financial behavior. However, financial literacy is subject to the endogeneity problem which makes the true effect of financial literacy unobservable. Endogeneity is due to three main reasons which are omitted variable bias, measurement error and reverse causality. To control for omitted variable bias, we consider demographic, socioeconomic, psychological and cultural

factors as determinants of our five proxies of financial behavior. Our research controls for the omitted variable bias by including cultural factors which are family ties and religiosity for the first time in a financial literacy study. To control for the financial literacy measurement error, we use two proxy measures of financial literacy where the first proxy is the "big three: financial literacy questions of Lusardi and Mitchell (2011c) which address interest rates, inflation and diversification. We use another proxy for financial literacy which combines the "big three" questions with three numeracy questions. The decision to add the numeracy questions stems from the evidence of a significant effect of numeracy on financial behavior measures. In addition, to control for reverse causality, we compare aspect of our sample selection in which we select Germanic, Arabic and Latin European sub samples to compare the determinants of financial behavior measures across different regions. Another way to control for endogeneity of financial literacy is using instrumental variables in our regression analysis. We use mother's education, math skills at the age of 10 and need for cognition as instruments for financial literacy. Using AI, we apply Regression Trees, Random Forests and Quantile Regression Forests due to their ability to predict that most important drivers of financial behavior.

We validate our empirical model with micro-economic data. We use a cross region survey collected across Arabic, Germanic and Latin European countries. Our dependent variable consists of five proxy measures of financial behavior which are active savings, budgeting, punctual debt payment, stock market participation and retirement savings, and our independent variables are two proxies of financial literacy, financial socialization by parents, numeracy, two proxies of family ties, religiosity, impatience, confidence, risk-taking and a vector of demographics.

We conduct our analysis for every dependent variable proxy. We apply OLS regressions with fixed effects, IV regressions, Generalized Method of Moments, Principal Component Analysis and Principal Component Regressions. In our IV regression and GMM, our endogenous variables are numeracy and financial literacy. Our instruments are math skills at the age of 10, need for cognition, mother's education and language proficiency. The IV regressions and diagnostics show the validity of our selected instruments.

The applied algorithms consist of Regression Trees and Random Forest analysis. The advantage of using these techniques is predicting the most important variables that describe financial behavior.

Regarding our first proxy for financial behavior which is active saving, the results are consistent over the different

techniques and show that psychological factors and cultural traits are the main determinants and predictors of active savings. As opposed to previous findings, financial literacy and numeracy have a weak effect on active savings. In the regressions, family ties, religiosity, confidence, risk-taking, education, Germanic individuals, household income and females are positively attributed to active savings. Also, impatience is negatively associated with active savings. Using the Random Forest algorithm, we find that the main predictors of active savings are impatience, financial socialization, confidence, gender, religiosity, geographic region, family ties, age, religion, risk-taking, household income, education, financial literacy, studied business/economics at university, marital status and numeracy.

In our study, financial socialization by parents is the most important driver of active savings. We suggest that financial education programs focus on educating parents on finances and provide incentives to them to educate their children on financial matters. That is, we suggest that educating parents about how important it is to financially socialize with their children may be a good tool for improving financial behavior. Moreover, the importance of psychological factors on financial behavior can highlight the importance of promoting psychological health of individuals which would in turn improve financial behavior.

We run the same regressions using our second proxy for financial literacy and the results are consistent with our findings. However, the R squared of our regression model using our first proxy of financial literacy is higher. The same result applies to the remaining regressions using our other proxies of financial behavior.

In our second proxy of financial behavior which is budgeting, we find that using our different empirical approaches, financial literacy, numeracy, financial socialization, Latin Europeans, religiosity, Muslims and confidence have a positive effect on budgeting. In addition, impatience and males have a negative effect on budgeting. Using three machine learning algorithms, we find that the main drivers of budgeting are impatience, financial socialization, geographic region, confidence, religiosity, studied business/economics at university, risk-taking, gender, education, religion, numeracy, family ties, age, financial literacy, household income and marital status. As psychological traits are hard to control for in financial education programs, public policies that protect and assist individuals with their finances may be needed such as automated saving plans which automatically transfer a part of an individual's salary into their savings account.

To conclude, regarding our third proxy of financial behavior which is punctual debt payment, we find that financial

literacy, numeracy, confidence, strong family ties, financial socialization by parents, household income, Germanic individuals and religiosity have a positive influence on punctual debt payment. In addition, impatience and risk have a negative effect on punctual debt payment. We also find that the main predictors of punctual debt payment are family ties, financial socialization, confidence, household income, financial literacy, impatience, religion, risk-taking, numeracy, geographic region, religiosity, age, education, studied business/economics at university, gender and marital status. The importance of family ties in determining budgeting behavior suggests the need to implement financial education programs that target communities with strong family ties.

Concerning our forth proxy of financial behavior which is stock market participation, we find that the effect on stock participation is associated with males, age, financial literacy, numeracy, family ties, financial socialization by parents, education and household income. The results are consistent with the literature and our research shows that family ties and religiosity are negatively associated with stock market participation. In the regressions, financial literacy, financial socialization by parents, numeracy, risk-taking, age, Germanic individuals, household income and males are positively associated with stock market participation. Also, family ties, religiosity and impatience are negatively associated with stock market participation. Using Random Forests, the most important drivers of stock market participation are age, religiosity, gender, family ties, religion, financial literacy, geographic region, household income, impatience, confidence, education, marital status, numeracy, risk-taking, studied business/economics at university and financial socialization. This suggests the need to take demographic differences into consideration in the design of financial education programs.

Our last proxy measure of financial behavior is saving for retirement and it is associated with marital status, confidence and age. In addition, saving for retirement is negatively associated with family ties, religiosity and impatience. In the regressions, saving for retirement is positively associated with confidence, financial socialization, married individuals, age, Muslims and Arabs. In addition, saving for retirement is negatively associated with family ties, religiosity and impatience. In the regressions, financial literacy has no effect on retirement saving. Using Random forest algorithm, the most important drivers of retirement saving are confidence, marital status, geographic region, family ties, impatience, age, education, religion, financial literacy, financial socialization, numeracy, risk-taking, gender, household income, studied business/economics at university and religiosity.

We conclude that individuals with strong family ties and religiosity may rely on other sources for retirement savings

such as inheritance and family support. In addition, married individuals save more for retirement when compared to single individuals. This shows that married couples take saving for retirement more seriously than single individuals.

Even though financial literacy and financial socialization are positively associated with financial behavior, it is apparent the cultural factors such as religiosity and family ties, and psychological factors such as risk-taking, confidence and impatience are also main drivers of financial behavior. These findings suggest that changes could be made to financial education programs and that relying solely on educating individuals with financial concepts may not sufficiently improve financial behavior. In fact, taking into account the cultural and psychological differences of individuals in financial education program can improve the quality of financial education. Our research suggests the need for implementing financial education programs based on individual cultural and psychological differences, which in turn will improve financial behavior.

If financial socialization continues to be the most influential determinant of financial behavior, governments can target parents in their financial education curricula. Also, in countries with strong family ties, governments can invest in financial education programs for parents, which will allow parents to financially socialize with their children to improve their financial literacy and financial behavior. Moreover, in religious countries, financial education programs can also be introduced in places of worship by educating religious leaders. This can be done by conducting financial education programs to religious leaders who can give financial literacy and financial behavior incentives to their followers. To improve financial behavior, we suggest new public policies that aim to improve the financial well-being of individuals due to the difficulty of controlling for psychological traits such as impatience and confidence in financial education programs.

We recommend more experimental studies exploring the implementation of different approaches related to financial literacy, financial socialization, cultural and psychological traits, in constructing financial education programs that can be effective in improving financial behavior across different cultures and countries. Lab and field experiments shed light on methods that improve the financial behavior of individuals. In addition, lab and field experiments can help identify if financial literacy can consistently improve financial behavior.

5.4 Recommendations

Financial literacy studies are still in the early phase on proving the importance of improving the financial literacy of individuals. Most financial education programs around the world make the assumption that increasing financial literacy improves financial behavior. There is still no clear evidence that financial literacy improves financial behavior. In fact, our findings show that financial literacy is not the only determinant of financial behavior and using different financial behavior proxies we find that sometimes financial literacy has no effect at all. Financial literacy may be one way to improve financial behavior, but it is not exhaustive. Our research shows that the cultural and psychological effect on financial behavior refutes the idea of relying solely on financial literacy to improve financial behavior. Even though financial education programs are increasing globally, it is too soon to rely solely on financial education programs before finding the true determinants of financial literacy and financial behavior. Instead of proceeding with the application of financial education programs, we suggest that researchers devote time and effort towards finding what affects the individual's financial behavior, where and why. We further recognizing the challenge of conducting a universal financial education program due to the vast diversity of culture, tradition and behavior. Financial education programs have to be adjusted to the appropriate culture and tradition in order to be effective. In addition, relying solely on educating the people about financial concepts does not appear to effectively improve financial behavior. Cultural concepts like religiosity and family ties, and psychological concepts such as risk-taking and impatience should be taken into account while implementing financial education programs. We suggest that financial education programs should target parents because of parental influence on children in regions with strong family ties and high level of religiosity. Another reason for educating parents on finances is the evidence of an impact of financial socialization by parents on financial behavior. In our study, impatience is associated with poorer financial behavior among individuals. Because it is harder to change people's character, government policies can be applied to help impatient individuals with their financial behavior. For example, financial technology can be applied by automatically withdrawing a part of an individual's income so that it can be placed in a saving account. This solution is suitable for those who find it hard to save or control their expenses. Even though there is evidence of higher levels of financial literacy among males, females tend to have a better financial behavior when it comes to active savings and budgeting. This analogy shows that financial literacy is not always a reference for a better financial behavior. On the other hand, males have a higher tendency to participate in stock markets.

Beyond educating individuals about finance, much more is needed to effectively improve financial behavior. We

recommend a custom and targeted financial education programs and public policies that suit a geographic region, cultural and psychological differences to better improve financial behavior. As financial education programs and public policies can be implemented in different ways, we recommend the application of experimental studies that better account for financial behavior and new financial education programs that are suitable for specific sample groups.

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Appendices

Appendix A

FAMILY TIES AND INVESTMENT IN FINANCIAL LITERACY

We present some additional information that elaborate on some topics in our first paper.

A.1 SHARE numeracy score (current financial literacy)

The questions used to construct the financial literacy indicator are set out below. Possible answers are shown on cards displayed by the interviewer who is instructed not to read them out to respondents: 1. "If the chance of getting a disease is 10%, how many people out of 1000 can be expected to get the disease?" The possible answers are 100, 10, 90, 900 and another answer. 2. "In a sale, a shop is selling all items at half price. Before the sale a sofa costs 300 euro. How much will it cost in the sale?" The possible answers are 150, 600 and another answer. 3. "A second hand car dealer is selling a car for 6000 euro. This is two-thirds of what it costs new. How much did the car cost new?" The possible answers are 9000, 4000, 8000, 12,000, 18,000 and another answer. 4. "Let's say you have 2000 euro in a savings account. The account earns 10 per cent interest each year. How much would you have in the account at the end of the second year?" The possible answers are 2420, 2020, 2040, 2100, 2200, 2400.

When a person answers (1) correctly he is then asked (3) and if he answers correctly again he is asked (4). Answering (1) correctly results in a score of 3, answering (3) correctly but not (4) results in a score of 4 while answering (4) correctly results in a score of 5. On the other hand if he answers (1) incorrectly he is directed to (2). If he answers (2) correctly he gets a score of 2 while if she answers (2) incorrectly he gets a score of 1.

A.2 SHARE Mathematical and language fluency (initial financial literacy and initial language fluency)

WAVE 3 SHARELIFE is a module on childhood that asks about living conditions, accommodation, and family structure of the respondents in SHARE WAVE data. The WAVE 3 SHARELIFE module asks questions about mathematical ability at 10 years of age. The exact wording of the question is: "Now I would like you to think back to your time in school when you were 10 years old. How did you perform in Maths compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?"

SHARELIFE asks a similar question about language skills: ".. how did you perform in your country's Language compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?"

A.3 SHARE wealth and indebtedness

We calculated wealth as the sum of real and financial assets and is imputed in case one or more items are missing. In addition to that, debt taken from total liabilities for an individual found in WAVE data.

Appendix B

DETERMINANTS OF FINANCIAL LITERACY

We present some additional information that elaborate on some topics in our paper.

B.1 Descriptive statistics

Variable	Levels	n	%	\sum %
geographic region	Arabic	300	50.0	50.0
	Germanic	149	24.8	74.8
	Latin Europe	151	25.2	100.0
	all	600	100.0	
country	Egypt	1	0.2	0.2
	Germany	63	10.5	10.7
	Italy	3	0.5	11.2
	Lebanon	289	48.2	59.3
	Netherlands	84	14.0	73.3
	Palestine	4	0.7	74.0
	Portugal	74	12.3	86.3
	Spain	74	12.3	98.7
	Syria	4	0.7	99.3
	Tunis	1	0.2	99.5
	UAE	3	0.5	100.0
	all	600	100.0	

Table B.1: Country descriptive statistics

Variable	Levels	n	%	\sum %
gender	Female	381	63.5	63.5
	Male	219	36.5	100.0
	all	600	100.0	
religion	Christian	194	32.3	32.3
	Muslim	258	43.0	75.3

	Other	148	24.7	100.0
	all	600	100.0	
household income	1001-1999	166	27.7	27.7
	2000-3999	167	27.8	55.5
	500-1000	110	18.3	73.8
	Less than 500	44	7.3	81.2
	More than 4000	113	18.8	100.0
	all	600	100.0	
marital status	Married	133	22.2	22.2
	Other	22	3.7	25.8
	Single	445	74.2	100.0
	all	600	100.0	
native language	Arabic	296	49.3	49.3
	Germanic	125	20.8	70.2
	Latin	156	26.0	96.2
	Other	23	3.8	100.0
	all	600	100.0	

Table B.2: Descriptive statistics for religion, marital status, household income, native language and gender

Variable	Levels	n	%	Σ %
education	Baccalaureate or less	53	8.8	8.8
	Post graduate	242	40.3	49.2
	University graduate	169	28.2	77.3
	University student	136	22.7	100.0
	all	600	100.0	
business/economics at university	No	326	54.3	54.3
	Yes	274	45.7	100.0
	all	600	100.0	
father education	Baccalaureate or less	374	62.3	62.3
	Post graduate	57	9.5	71.8
	University graduate	124	20.7	92.5
	University student	45	7.5	100.0

	all	600	100.0	
mother education	Baccalaureate or less	392	65.3	65.3
	Post graduate	45	7.5	72.8
	University graduate	124	20.7	93.5
	University student	39	6.5	100.0
	all	600	100.0	

Table B.3: Descriptive statistics of the individual and parental education

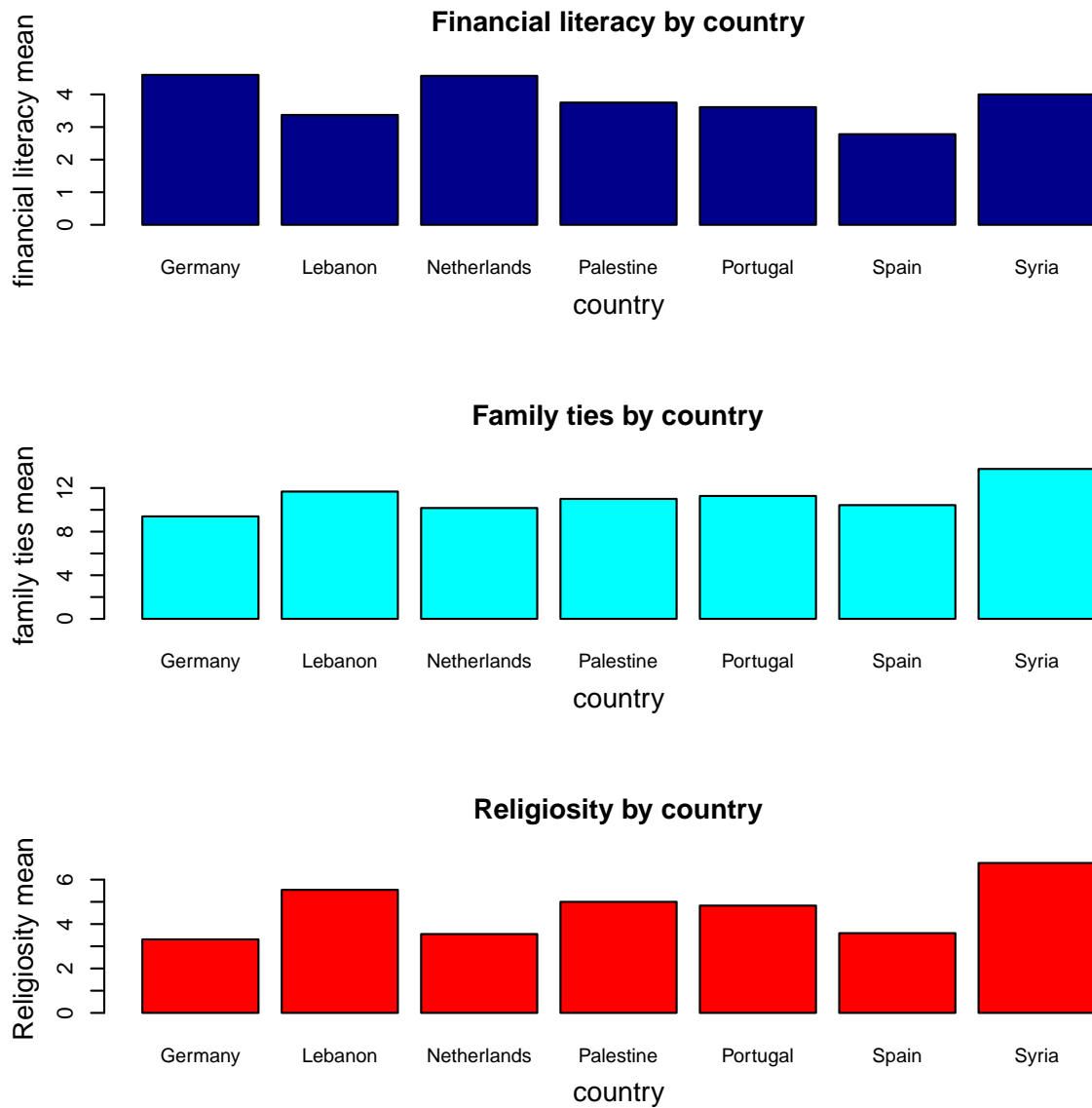


Figure B.1: Financial literacy, family ties and religiosity by country

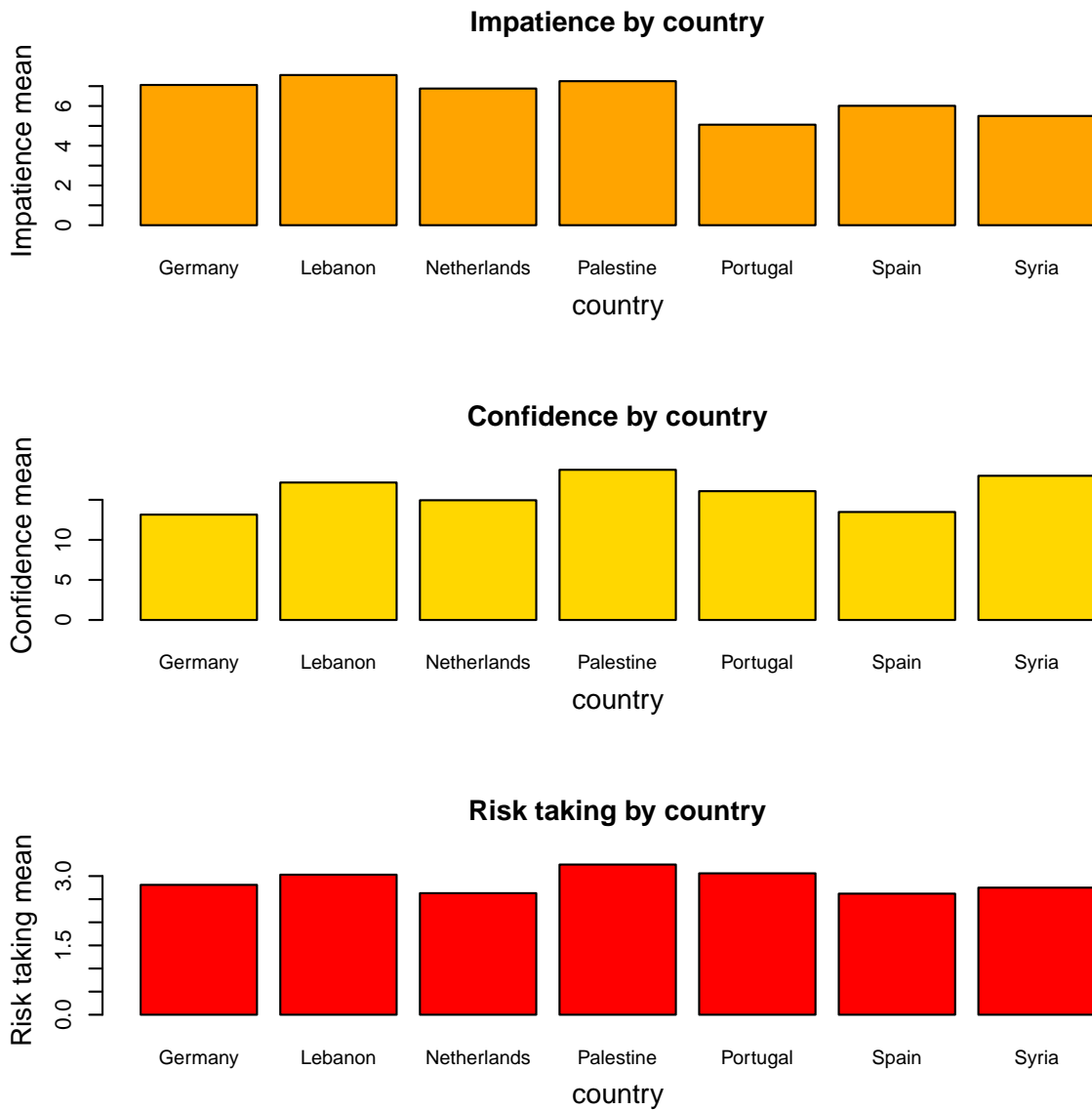


Figure B.2: Impatience, confidence and risk taking by country

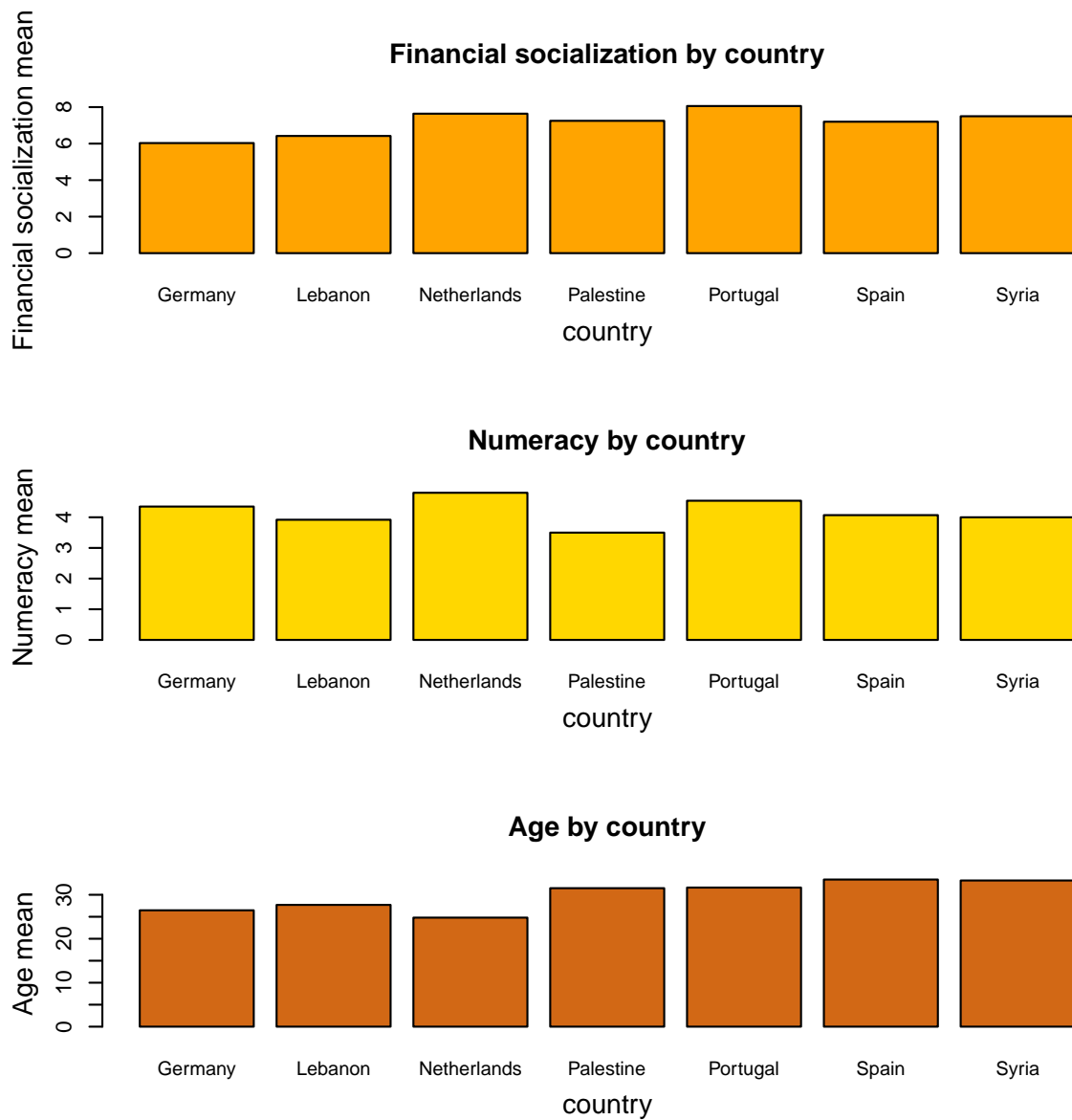


Figure B.3: Financial socialization by parents, numeracy and age by country

Table B.4: Descriptive statistics of the continuous variables for Lebanon

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	289	3.920	1.335	1	5
financial socialization by parents	289	6.426	2.115	2	10
financial literacy	289	3.377	1.488	1	5
cumulative financial literacy	289	7.298	2.238	2	10
math at 10	289	3.837	0.999	1	5
religiosity	289	5.547	2.137	2	10
family ties	289	11.675	2.409	3	15
confidence	289	17.163	3.786	5	25
impatience	289	7.564	2.984	3	15
age	289	27.696	7.609	16	70
language proficiency	289	2.727	0.446	2	3
need for cognition	289	17.599	3.721	5	25

Table B.5: Descriptive statistics of the continuous variables for Portugal

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	74	4.541	0.814	1	5
financial socialization by parents	74	8.068	1.778	4	10
financial literacy	74	3.608	1.226	1	5
cumulative financial literacy	74	8.149	1.685	4	10
math at 10	74	3.797	0.811	2	5
religiosity	74	4.838	2.643	2	10
family ties	74	11.270	2.009	6	15
confidence	74	16.081	3.892	6	25
impatience	74	5.068	2.223	3	15
age	74	31.649	10.590	19	57
language proficiency	74	2.635	0.485	2	3
need for cognition	74	20.189	3.033	11	25

Table B.6: Descriptive statistics of the continuous variables for Spain

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	74	4.068	1.220	1	5
financial socialization by parents	74	7.203	2.329	2	10
financial literacy	74	2.784	1.337	1	5
cumulative financial literacy	74	6.851	1.942	3	10
math at 10	74	3.554	0.862	2	5
religiosity	74	3.595	2.013	2	9
family ties	74	10.432	2.048	5	15
confidence	74	13.486	4.162	5	25
impatience	74	6.014	2.535	3	15
age	74	33.473	9.896	19	61
language proficiency	74	2.500	0.603	1	3
need for cognition	74	17.459	3.840	5	25

Table B.7: Descriptive statistics of the continuous variables for Germany

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	63	4.349	1.080	1	5
financial socialization by parents	63	6.032	2.032	2	10
financial literacy	63	4.603	0.908	2	5
financial literacy with numeracy	63	8.952	1.349	6	10
math at 10	63	4.000	1.063	2	5
religiosity	63	3.317	1.856	2	7
family ties	63	9.397	2.976	3	15
confidence	63	13.159	4.843	5	21
impatience	63	7.063	2.793	3	12
age	63	26.476	4.373	16	37
language proficiency	63	2.873	0.336	2	3
need for cognition	63	18.794	3.960	11	25

Table B.8: Descriptive statistics of the continuous variables in the Netherlands

Statistic	N	Mean	St. Dev.	Min	Max
numeracy	84	4.798	0.555	2	5
financial socialization by parents	84	7.643	1.534	2	10
financial literacy	84	4.571	0.960	2	5
cumulative financial literacy	84	9.369	1.073	7	10
math at 10	84	4.190	0.843	2	5
religiosity	84	3.560	2.241	2	10
family ties	84	10.167	1.706	6	14
confidence	84	14.952	3.474	7	20
impatience	84	6.881	2.372	3	14
age	84	24.798	6.150	18	57
language proficiency	84	2.667	0.588	1	3
need for cognition	84	19.869	2.723	12	25

B.2 Regression tables by geographic region

Table B.10: Regression results for cumulative financial literacy by geographic region using GMM

	Financial Literacy			Cumulative Financial Literacy		
	Arabic	Latin	Germanic	Arabic	Latin	Germanic
Intercept	2.91*** (0.90)	2.65 (3.13)	3.62*** (0.76)	-1.46 (3.47)	7.36* (3.99)	5.43*** (0.94)
numeracy	0.22 (0.20)	0.13 (0.16)	0.23 (0.17)			
math at 10				0.45** (0.22)	0.02 (0.49)	0.12 (0.13)
financial socialization	-0.19 (0.12)	-0.53 (0.52)	0.31*** (0.04)	1.24 (0.88)	-0.58 (0.47)	0.34* (0.18)
family ties	-0.07 (0.05)	-0.08 (0.07)	-0.21*** (0.05)	-0.18 (0.19)	-0.14 (0.10)	-0.07 (0.09)
religiosity	-0.02 (0.05)	0.14 (0.13)	0.08*** (0.03)	-0.33* (0.18)	0.06 (0.20)	0.18*** (0.07)
impatience	-0.04 (0.03)	-0.04 (0.08)	-0.00 (0.02)	-0.05 (0.07)	-0.14 (0.13)	0.04 (0.04)
confidence	0.19*** (0.06)	0.25 (0.29)	0.01 (0.01)	0.08 (0.23)	0.41 (0.47)	0.09** (0.04)
age	-0.05*** (0.01)	-0.00 (0.04)	-0.01 (0.01)	0.04 (0.04)	-0.00 (0.05)	-0.02* (0.01)
gender:male	0.35* (0.20)	0.04 (0.68)	0.15 (0.13)	0.91* (0.53)	-0.07 (0.76)	0.13 (0.21)
financial economics at university:yes	-0.31 (0.25)	-0.39 (0.76)	0.31 (0.20)	1.31 (0.93)	-0.30 (1.41)	0.65** (0.29)
education:Post graduate	0.85** (0.39)	0.44 (0.60)	-0.04 (0.26)	1.07 (1.19)	1.21 (1.01)	-1.04*** (0.36)
education:University graduate	0.84** (0.37)	0.55 (0.66)	0.44 (0.34)	1.29 (1.16)	0.57 (1.03)	-1.21*** (0.33)
education:University student	0.87* (0.44)	-0.11 (0.70)	-0.01 (0.28)	1.04 (1.20)	0.45 (0.99)	-1.09*** (0.33)
religion:Muslim	-0.96*** (0.28)	0.43 (1.17)	-0.29 (0.28)	-2.22** (0.92)	-0.02 (1.65)	-0.07 (0.49)
religion:Other	-0.86** (0.43)	0.65 (0.46)	0.13 (0.19)	-1.99 (1.28)	0.21 (0.78)	0.97*** (0.23)
household income:2000-3999	0.54** (0.24)	0.59 (0.39)	-0.51** (0.24)	0.49 (0.49)	0.11 (0.48)	0.25 (0.53)
household income:500-1000	0.48** (0.24)	-0.11 (0.76)	-0.41** (0.20)	-0.16 (0.67)	-0.84 (0.70)	0.43 (0.35)
household income:less than 500	0.25 (0.41)	0.39 (1.07)	-0.67** (0.29)	-0.60 (0.91)	-1.54 (1.79)	0.18 (0.39)
household income:more than 4000	0.71** (0.30)	0.24 (0.78)	-0.44 (0.33)	1.03 (0.70)	-0.65 (1.25)	0.82** (0.41)
marital status:Other	0.63 (0.46)	0.90 (0.89)		0.92 (0.90)	1.24 (1.52)	
marital status:Single	0.02 (0.21)	0.46 (0.54)		0.24 (0.53)	0.15 (0.83)	
Criterion function	12321.60	3507.40	8735.26	1045.77	2204.18	5511.65
Num. obs.	300	151	149	300	151	149

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B.3 Regression trees plots

Regression trees for financial literacy

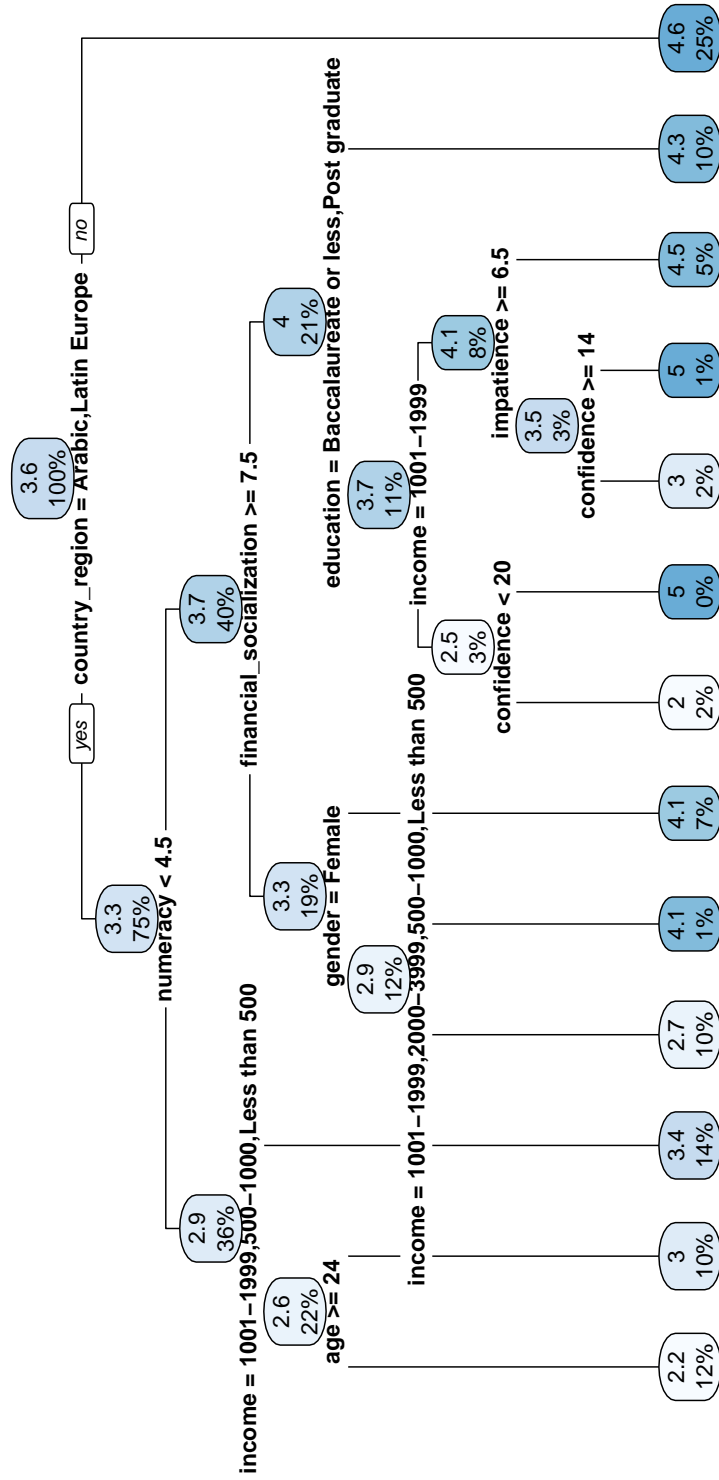


Figure B.4: Regression trees for financial literacy score

Appendix C

DETERMINANTS OF FINANCIAL BEHAVIOR

C.1 Descriptive Statistics

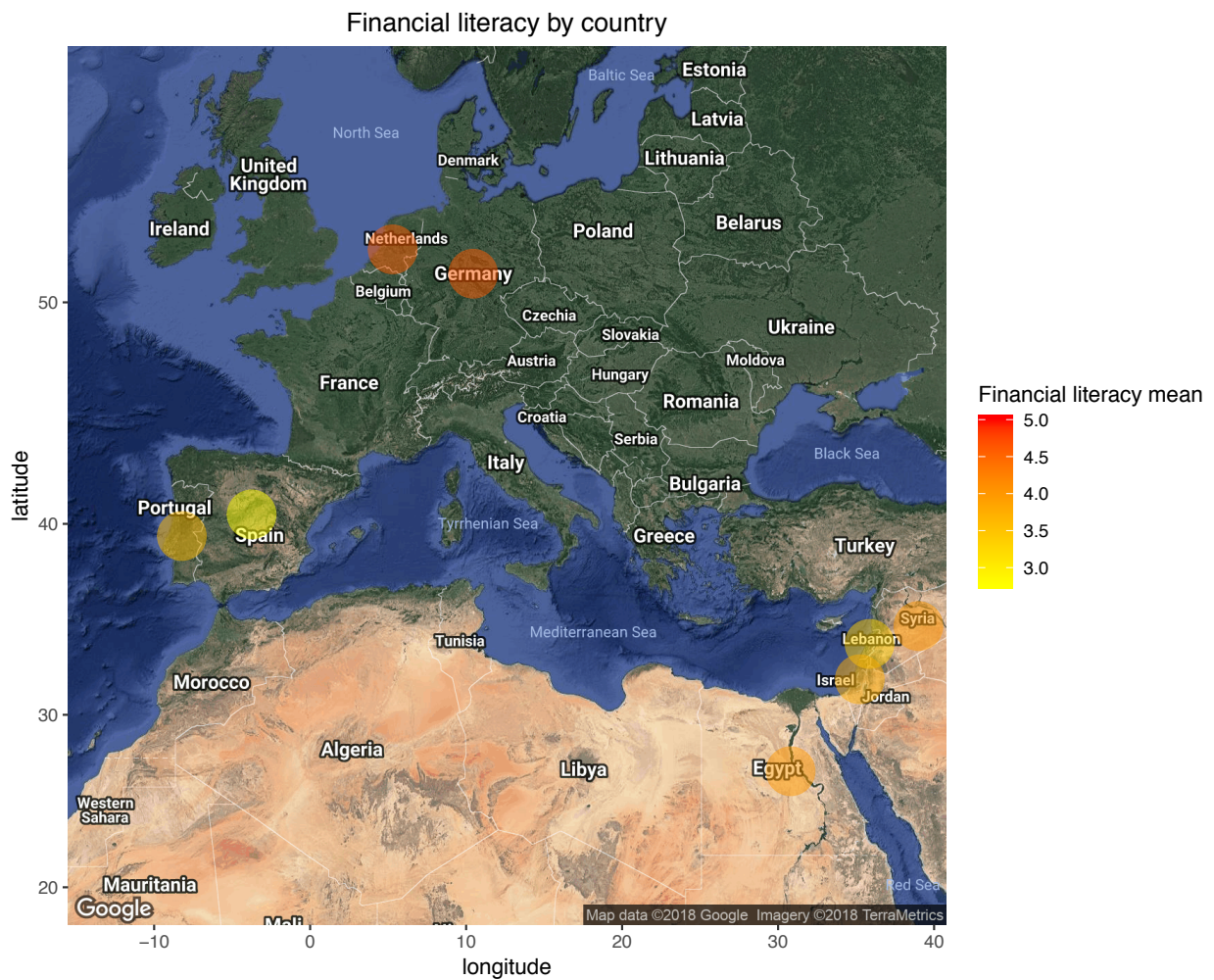


Figure C.1: Financial literacy by country

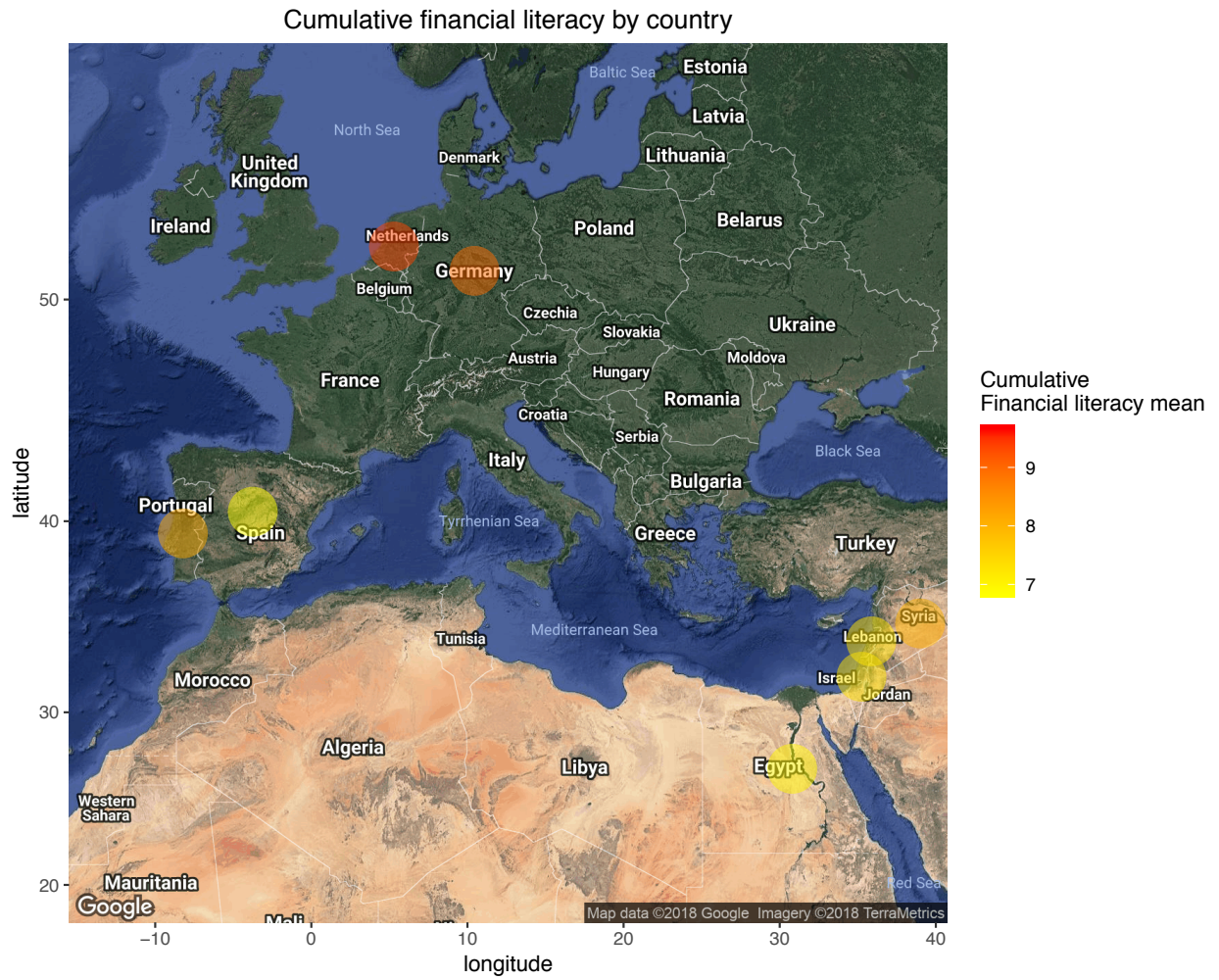


Figure C.2: Cumulative financial literacy by country

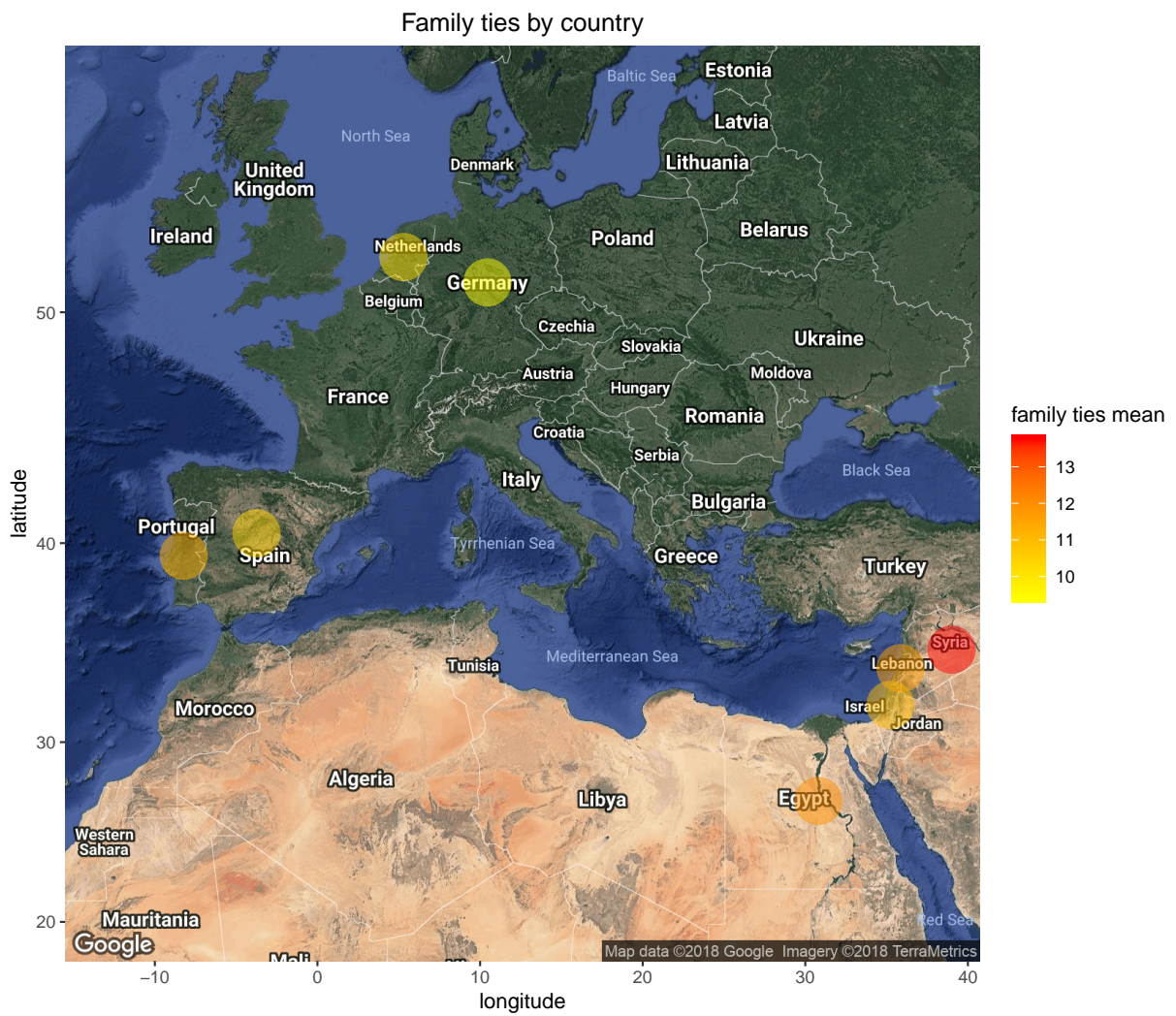


Figure C.3: Family ties by country

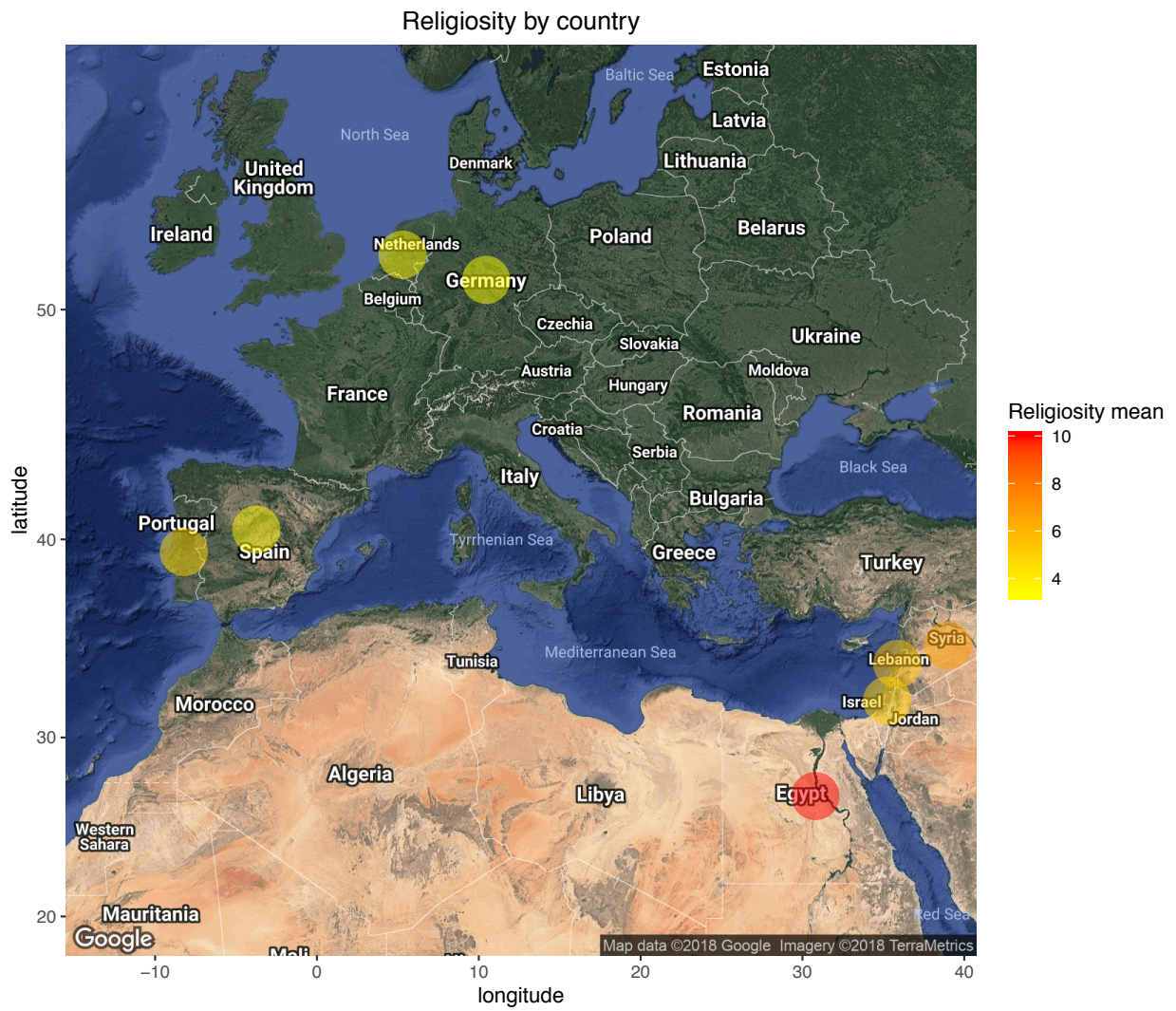
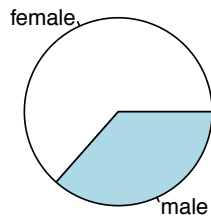
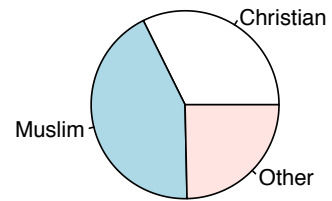


Figure C.4: Religiosity by country

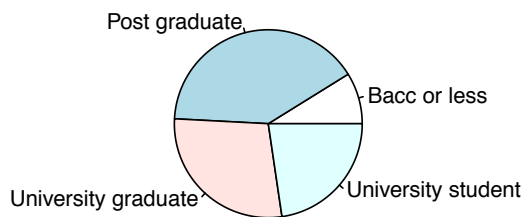
Sample distribution by gender



Sample distribution by religion



Sample distribution by education



Sample distribution by marital status

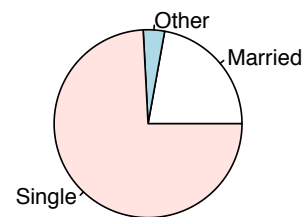


Figure C.5: Pie charts for gender, religion, education and marital status

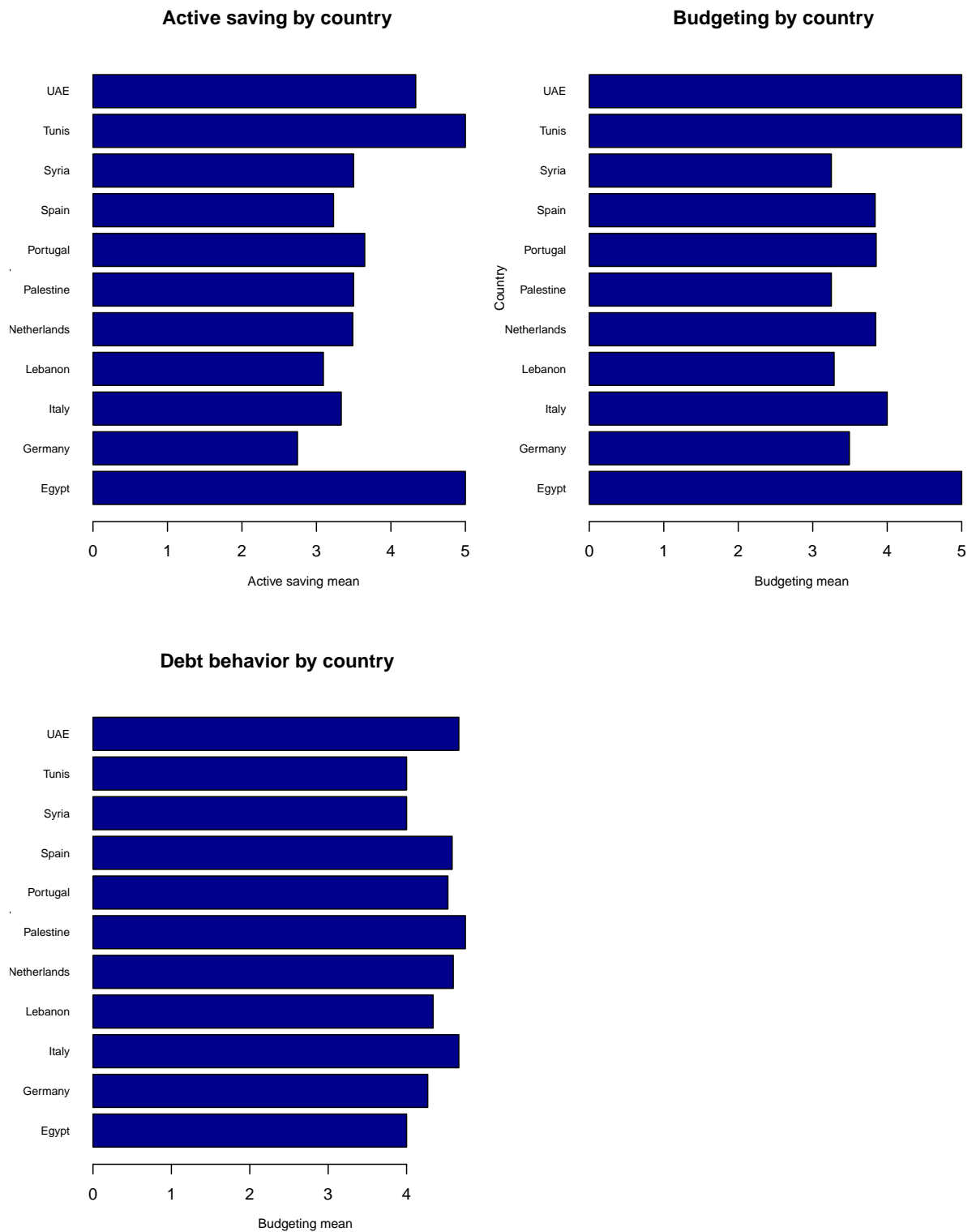


Figure C.6: Active saving, budgeting and debt behavior by country

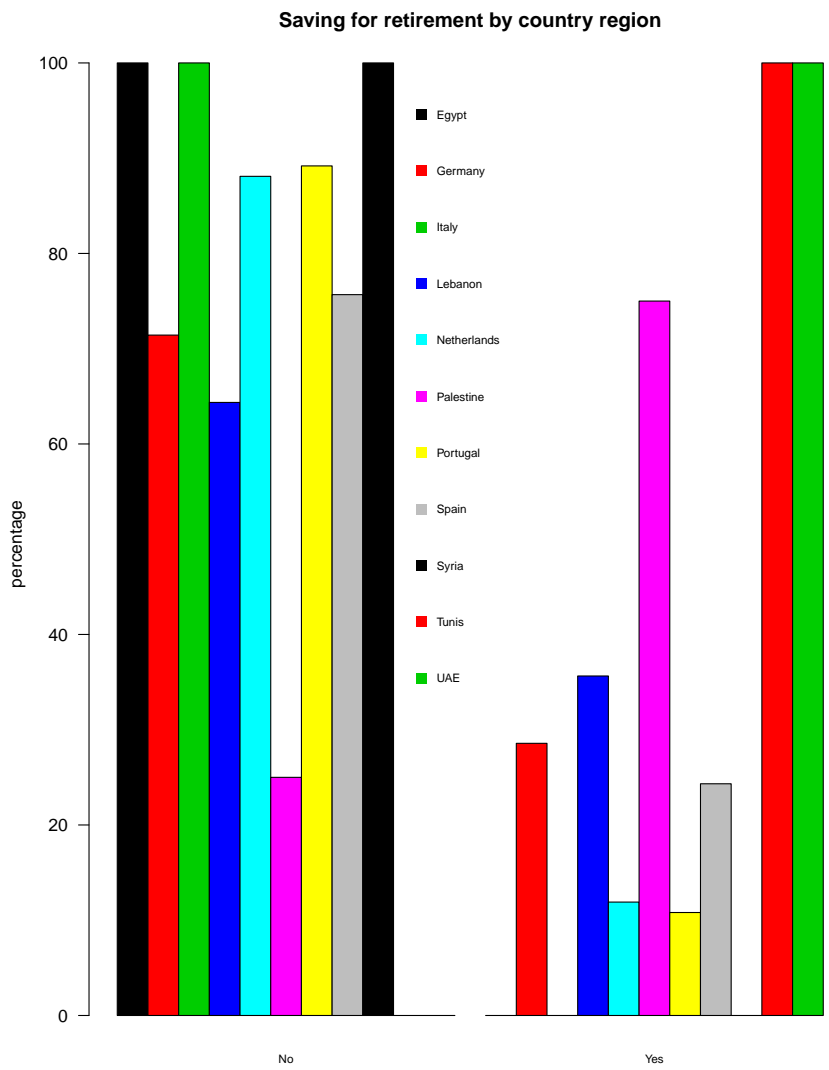


Figure C.7: Saving for retirement by country

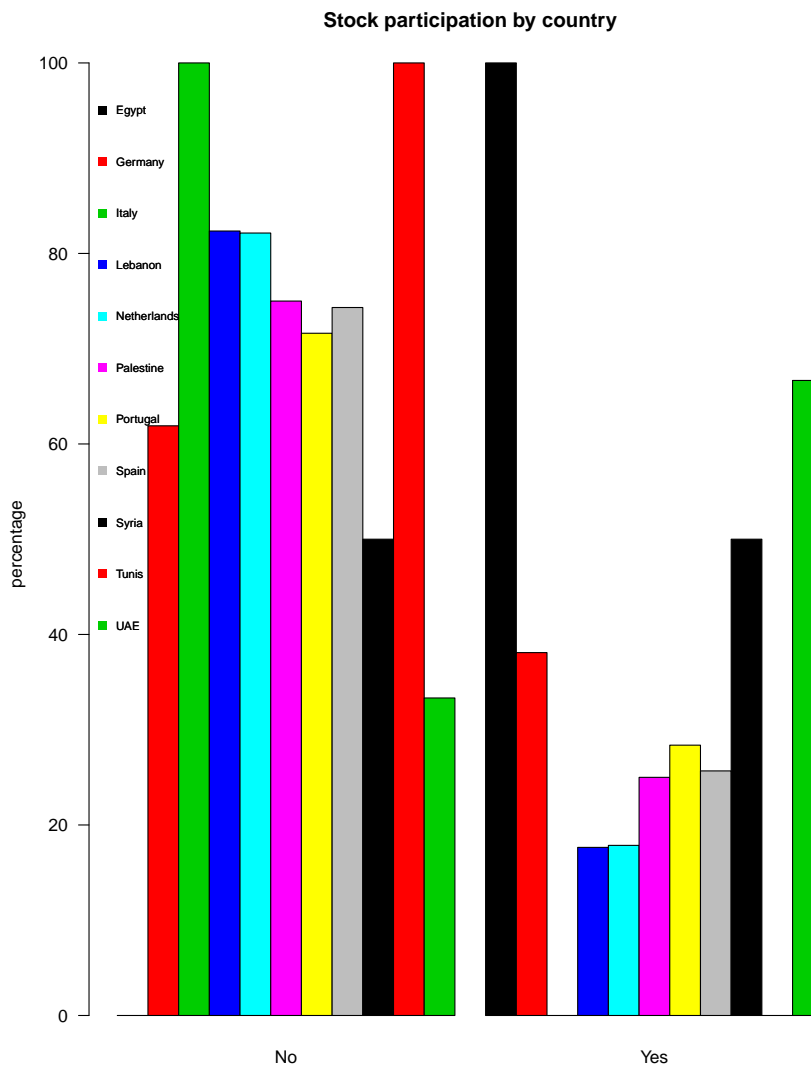


Figure C.8: Stock participation by country

Variable	Levels	n	%	Σ %
saving for retirement	No	436	72.7	72.7
	Yes	164	27.3	100.0
	all	600	100.0	
stock market participation	No	464	77.3	77.3
	Yes	136	22.7	100.0
	all	600	100.0	

Table C.1: Descriptive statistics for retirement saving and stock market participation

Variable	Levels	n _{Arabic}	% _{Arabic}	\sum % _{Arabic}	n _{Germanic}	% _{Germanic}	\sum % _{Germanic}	n _{LatinEurope}	% _{LatinEurope}	\sum % _{LatinEurope}
gender	Female	185	61.7	61.7	96	64.4	64.4	100	66.2	66.2
	Male	115	38.3	100.0	53	35.6	100.0	51	33.8	100.0
	all	300	100.0		149	100.0		151	100.0	
religion_categorical	Christian	32	10.7	10.7	68	45.6	45.6	94	62.2	62.2
	Muslim	245	81.7	92.3	6	4.0	49.7	7	4.6	66.9
	Other	23	7.7	100.0	75	50.3	100.0	50	33.1	100.0
	all	300	100.0		149	100.0		151	100.0	
household_income	1001-1999	96	32.0	32.0	23	15.4	15.4	47	31.1	31.1
	2000-3999	75	25.0	57.0	42	28.2	43.6	50	33.1	64.2
	500-1000	55	18.3	75.3	25	16.8	60.4	30	19.9	84.1
	Less than 500	22	7.3	82.7	19	12.8	73.2	3	2.0	86.1
	More than 4000	52	17.3	100.0	40	26.9	100.0	21	13.9	100.0
	all	300	100.0		149	100.0		151	100.0	
marital_status	Married	82	27.3	27.3	11	7.4	7.4	40	26.5	26.5
	Other	15	5.0	32.3	2	1.3	8.7	5	3.3	29.8
	Single	203	67.7	100.0	136	91.3	100.0	106	70.2	100.0
	all	300	100.0		149	100.0		151	100.0	
native_language	Arabic	281	93.7	93.7	7	4.7	4.7	8	5.3	5.3
	Germanic	0	0.0	93.7	123	82.5	87.2	2	1.3	6.6
	Latin	7	2.3	96.0	9	6.0	93.3	140	92.7	99.3
	Other	12	4.0	100.0	10	6.7	100.0	1	0.7	100.0
	all	300	100.0		149	100.0		151	100.0	

Table C.2: Descriptive statistics of categorical variables by geographic region

Variable	Levels	nGermany	%Germany	Σ %Germany	nAustria	%Austria	Σ %Austria	nNetherlands	%Netherlands	Σ %Netherlands	nPortugal	%Portugal	Σ %Portugal	nSpain	%Spain	Σ %Spain	nAll	%All	Σ %All
gender	Female	40	63.5	63.5	181	62.6	62.6	55	65.5	65.5	41	55.4	55.4	56	75.7	75.7	191	32.7	32.7
	Male	23	36.5	100.0	108	37.4	100.0	29	34.5	100.0	33	44.6	100.0	18	24.3	100.0	211	36.1	63.9
	all	63	100.0		289	100.0		84	100.0		74	100.0		74	100.0		584	100.0	100.0
religion_categorical	Christian	29	46.0	46.0	31	10.7	10.7	38	45.2	45.2	46	62.2	62.2	47	63.5	63.5	191	32.7	32.7
	Muslim	5	7.9	54.0	236	81.7	92.4	0	0.0	45.2	6	8.1	70.3	0	0.0	63.5	247	42.3	75.0
	Other	29	46.0	100.0	22	7.6	100.0	46	54.8	100.0	22	29.7	100.0	27	36.5	100.0	146	25.0	100.0
	all	63	100.0		289	100.0		84	100.0		74	100.0		74	100.0		584	100.0	100.0
household_income	1001-1999	13	20.6	20.6	95	32.9	32.9	10	11.9	11.9	17	23.0	23.0	29	39.2	39.2	164	28.1	28.1
	2000-3999	20	31.8	52.4	71	24.6	57.4	21	25.0	36.9	25	33.8	56.8	24	32.4	71.6	161	27.6	55.6
	500-1000	4	6.3	58.7	53	18.3	75.8	21	25.0	61.9	19	25.7	82.4	11	14.9	86.5	108	18.5	74.1
	Less than 500	12	19.1	77.8	20	6.9	82.7	7	8.3	70.2	2	2.7	85.1	1	1.4	87.8	42	7.2	81.3
More than 4000	14	22.2	100.0	30	17.3	100.0	25	29.8	100.0	11	14.9	100.0	9	12.2	100.0	109	18.7	100.0	
all	63	100.0		289	100.0		84	100.0		74	100.0		74	100.0		584	100.0	100.0	
marital_status	Married	6	9.5	9.5	78	27.0	27.0	4	4.8	4.8	20	27.0	27.0	19	25.7	25.7	127	21.8	21.8
	Other	0	0.0	9.5	14	4.8	31.8	2	2.4	7.1	2	2.7	29.7	3	4.0	29.7	21	3.6	25.4
	Single	57	90.5	100.0	197	68.2	100.0	78	92.9	100.0	52	70.3	100.0	52	70.3	100.0	436	74.7	100.0
all	63	100.0		289	100.0		84	100.0		74	100.0		74	100.0		584	100.0	100.0	
native_language	Arabic	5	7.9	7.9	272	94.1	94.1	0	0.0	0.0	7	9.5	9.5	0	0.0	0.0	284	48.6	48.6
	Germanic	52	82.5	90.5	0	0.0	94.1	71	84.5	84.5	0	0.0	9.5	2	2.7	2.7	125	21.4	70.0
	Latin	3	4.8	95.2	7	2.4	96.5	6	7.1	91.7	66	89.2	98.7	72	97.3	100.0	154	26.4	96.4
	Other	3	4.8	100.0	10	3.5	100.0	7	8.3	100.0	1	1.4	100.0	0	0.0	100.0	21	3.6	100.0
all	63	100.0		289	100.0		84	100.0		74	100.0		74	100.0		584	100.0	100.0	

Table C.3: Descriptive statistics of nominal variables by country

C.2 Complete regressions using 5 proxies of financial behavior

APPENDIX C. DETERMINANTS OF FINANCIAL BEHAVIOR

Dependent variable: active saving	Financial Literacy					Cumulative Financial Literacy				
	GMM	IVFE	OLSFE3	OLSFE2	OLSFE1	GMM	IVFE	OLSFE3	OLSFE2	OLSFE1
Intercept	2.89*** (0.91)					2.83*** (0.90)				
financial literacy	-0.31 (0.24)									
cumulative financial literacy										
numeraary	-0.29 (0.23)	-0.66 (0.48)	-0.08* (0.04)	-0.05 (0.05)	-0.05 (0.05)	-0.28*** (0.12)	-0.25*** (0.13)	-0.02 (0.03)	0.02 (0.03)	0.01 (0.03)
financial socialization	0.18*** (0.03)	0.13*** (0.04)	0.18*** (0.02)	0.20*** (0.03)	0.20*** (0.03)	0.18*** (0.03)	0.16*** (0.03)	0.18*** (0.02)	0.20*** (0.03)	0.20*** (0.03)
family ties	0.03 (0.03)	0.06 (0.04)	0.02 (0.02)	0.00 (0.02)		0.03 (0.03)	0.03 (0.03)	0.02 (0.02)	0.00 (0.02)	
religiosity	0.05 (0.03)	0.04 (0.04)	0.05* (0.02)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.05* (0.03)	0.04 (0.03)	0.04 (0.03)
impatience	-0.17*** (0.02)	-0.19*** (0.03)	-0.15*** (0.02)			-0.17*** (0.02)	-0.17*** (0.02)	-0.15*** (0.02)		
confidence	0.05 (0.05)	-0.00 (0.05)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)	0.05 (0.02)	0.04** (0.02)	0.03** (0.01)	0.03** (0.01)	0.03** (0.01)
risk	0.09 (0.06)	0.80 (0.62)	0.06 (0.05)	0.06 (0.05)	0.06 (0.05)	0.09 (0.05)	0.08 (0.05)	0.07 (0.05)	0.07 (0.05)	0.01 (0.01)
age	0.00 (0.01)	0.03 (0.02)	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.00 (0.01)
gender:male	-0.22 (0.14)	-0.46* (0.24)	-0.36*** (0.11)	-0.26*** (0.11)	-0.25*** (0.11)	-0.25*** (0.13)	-0.27*** (0.12)	-0.35*** (0.11)	-0.25*** (0.11)	-0.24*** (0.11)
business/economics at university:yes	0.15 (0.14)	0.06 (0.19)	-0.01 (0.12)	0.04 (0.12)	0.05 (0.12)	0.14 (0.14)	0.11 (0.14)	-0.01 (0.12)	0.03 (0.12)	0.04 (0.12)
education:Post graduate	0.24 (0.17)	0.32 (0.28)	0.11 (0.19)	0.15 (0.20)	0.14 (0.20)	0.26 (0.16)	0.17 (0.20)	0.12 (0.19)	0.15 (0.20)	0.14 (0.20)
education:University graduate	0.20 (0.21)	0.37 (0.32)	0.13 (0.20)	0.13 (0.21)	0.10 (0.21)	0.23 (0.18)	0.19 (0.21)	0.15 (0.20)	0.16 (0.21)	0.12 (0.21)
education:University student	0.18 (0.19)	0.44 (0.34)	0.13 (0.20)	0.10 (0.21)	0.06 (0.21)	0.17 (0.18)	0.20 (0.22)	0.14 (0.20)	0.10 (0.21)	0.07 (0.21)
geographic region:Germanic	0.75*** (0.27)	0.35 (0.26)	0.31* (0.19)	0.29 (0.20)	0.29 (0.20)	0.71*** (0.25)	0.31 (0.20)	0.29 (0.19)	0.27 (0.20)	0.27 (0.20)
geographic region:Latin Europe	0.09 (0.20)	0.42 (0.34)	0.22 (0.22)	0.08 (0.22)	0.07 (0.22)	0.07 (0.18)	0.20 (0.22)	0.21 (0.22)	0.07 (0.22)	0.06 (0.22)
religion:Muslim	0.04 (0.19)	-0.02 (0.25)	0.17 (0.17)	0.15 (0.18)	0.14 (0.18)	0.03 (0.19)	0.04 (0.19)	0.16 (0.17)	0.13 (0.18)	0.13 (0.18)
religion:Other	0.12 (0.13)	0.09 (0.19)	0.02 (0.14)	-0.06 (0.15)	-0.16 (0.14)	0.10 (0.13)	0.07 (0.15)	0.01 (0.14)	0.01 (0.15)	-0.16 (0.14)
household income:2000-3999	0.41* (0.22)	0.26 (0.28)	0.21 (0.13)	0.17 (0.14)	0.15 (0.14)	0.39*** (0.16)	0.36*** (0.15)	0.24* (0.13)	0.20 (0.14)	0.19 (0.14)
household income:500-1000	0.11 (0.21)	-0.03 (0.27)	-0.09 (0.15)	-0.23 (0.16)	-0.25 (0.16)	0.08 (0.16)	0.02 (0.16)	-0.07 (0.15)	-0.20 (0.16)	-0.22 (0.15)
household income:less than 500	0.13 (0.29)	0.20 (0.35)	0.14 (0.21)	0.12 (0.22)	0.10 (0.22)	0.16 (0.22)	0.15 (0.22)	0.18 (0.21)	0.17 (0.22)	0.15 (0.22)
household income:more than 4000	0.42* (0.25)	0.22 (0.32)	0.10 (0.15)	0.08 (0.16)	0.06 (0.16)	0.38* (0.21)	0.33* (0.20)	0.12 (0.15)	0.11 (0.16)	0.09 (0.16)
marital status:Other	0.54* (0.28)	0.46 (0.38)	0.36 (0.27)	0.23 (0.29)	0.19 (0.29)	0.48* (0.28)	0.48 (0.30)	0.37 (0.27)	0.24 (0.29)	0.20 (0.29)
marital status:Single	0.23 (0.17)	0.36 (0.23)	0.15 (0.14)	0.17 (0.15)	0.15 (0.15)	0.23 (0.16)	0.22 (0.16)	0.14 (0.14)	0.16 (0.15)	0.15 (0.15)
Criterion function	858.48					519.99				
Nurm. obs.	600					600				
R ²	0.11		0.26	0.16	0.15	0.19		0.26	0.15	0.15
Adj. R ²	0.05		0.22	0.11	0.11	0.14		0.21	0.11	0.11
Nurm. obs.	600		600	600	600	600		600	600	600

Dependent variable: budgeting	Financial Literacy					Cumulative Financial Literacy				
	GMM	IVFE	OLSFE3	OLSFE2	OLSFE1	GMM	IVFE	OLSFE3	OLSFE2	OLSFE1
Intercept	-1.15 (1.25)					-1.16 (1.20)				
financial literacy	0.85*** (0.27)	0.85*** (0.30)	-0.01 (0.04)	0.02 (0.04)	0.02 (0.04)	0.47** (0.20)	0.59** (0.24)	-0.00 (0.03)	0.03 (0.03)	0.03 (0.03)
cumulative financial literacy										
numeracy	0.06 (0.32)	0.15 (0.40)	0.01 (0.04)	0.04 (0.05)	0.04 (0.05)					
financial socialization	0.17*** (0.04)	0.18*** (0.04)	0.15*** (0.03)	0.18*** (0.03)	0.18*** (0.03)	0.16*** (0.03)	0.18*** (0.04)	0.15*** (0.03)	0.18*** (0.03)	0.18*** (0.03)
family ties	-0.01 (0.04)	-0.01 (0.04)	-0.00 (0.02)	-0.00 (0.02)	-0.00 (0.02)	-0.03 (0.03)	-0.03 (0.03)	0.00 (0.02)	-0.00 (0.02)	-0.00 (0.02)
religiosity	0.09*** (0.03)	0.10*** (0.04)	0.09*** (0.03)	0.07*** (0.03)	0.07*** (0.03)	0.09*** (0.03)	0.10*** (0.04)	0.09*** (0.03)	0.07*** (0.03)	0.07*** (0.03)
impatience	-0.06** (0.03)	-0.06** (0.03)	-0.11*** (0.02)			-0.07*** (0.03)	-0.07*** (0.03)	-0.11*** (0.02)		
confidence	0.02 (0.02)	0.02 (0.03)	0.05*** (0.01)			0.02 (0.02)	0.01 (0.02)	0.05*** (0.01)		
risk	-0.03 (0.08)	-0.02 (0.07)	0.05 (0.05)			-0.00 (0.07)	-0.00 (0.07)	0.05 (0.05)		
age	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)			0.01 (0.01)	0.01 (0.01)	0.01 (0.01)		
gender: male	-0.28 (0.17)	-0.29* (0.18)	-0.05 (0.11)	0.07 (0.11)	0.07 (0.11)	-0.24 (0.15)	-0.26 (0.17)	-0.05 (0.11)	0.06 (0.11)	0.07 (0.11)
business/economics at university: yes	-0.32* (0.19)	-0.35 (0.22)	-0.08 (0.12)	0.01 (0.12)	0.01 (0.12)	-0.36** (0.17)	-0.41* (0.21)	-0.08 (0.12)	0.01 (0.12)	0.02 (0.12)
education: Post graduate	-0.25 (0.25)	-0.14 (0.28)	0.04 (0.19)	0.06 (0.20)	0.06 (0.20)	-0.24 (0.22)	-0.10 (0.27)	0.03 (0.19)	0.08 (0.20)	0.06 (0.20)
education: University graduate	-0.22 (0.28)	-0.18 (0.30)	0.07 (0.20)	0.08 (0.21)	0.01 (0.21)	-0.05 (0.24)	-0.04 (0.28)	0.06 (0.20)	0.07 (0.21)	0.01 (0.21)
education: University student	-0.28 (0.26)	-0.28 (0.29)	-0.08 (0.20)	-0.09 (0.21)	-0.16 (0.21)	-0.19 (0.23)	-0.23 (0.28)	-0.08 (0.20)	-0.09 (0.21)	-0.16 (0.21)
geographic region: Germanic	-0.27 (0.43)	0.07 (0.28)	-0.00 (0.19)	-0.01 (0.20)	-0.02 (0.20)	-0.11 (0.40)	-0.05 (0.26)	-0.00 (0.19)	-0.01 (0.20)	-0.01 (0.20)
geographic region: Latin Europe	0.60** (0.25)	0.06 (0.30)	0.00 (0.21)	-0.07 (0.22)	-0.09 (0.22)	0.47** (0.20)	0.03 (0.29)	0.00 (0.21)	-0.07 (0.22)	-0.09 (0.22)
religion: Muslim	0.52** (0.24)	0.64** (0.27)	0.30* (0.17)	0.31* (0.18)	0.29 (0.18)	0.56*** (0.21)	0.62** (0.27)	0.30* (0.17)	0.31* (0.18)	0.30* (0.18)
religion: Other	0.25 (0.19)	0.26 (0.21)	0.35** (0.14)	0.28** (0.15)	0.11 (0.14)	0.22 (0.17)	0.21 (0.20)	0.35** (0.14)	0.28** (0.15)	0.11 (0.14)
household income: 2000-3999	-0.57** (0.24)	-0.51** (0.25)	-0.02 (0.13)	-0.06 (0.14)	-0.09 (0.14)	-0.35* (0.18)	-0.34 (0.22)	-0.02 (0.13)	-0.07 (0.14)	-0.09 (0.14)
household income: 500-1000	-0.64*** (0.25)	-0.55** (0.26)	-0.15 (0.15)	-0.24 (0.16)	-0.28* (0.16)	-0.42** (0.20)	-0.36 (0.22)	-0.15 (0.15)	-0.25 (0.15)	-0.28* (0.15)
household income: less than 500	-0.56* (0.33)	-0.39 (0.36)	-0.17 (0.21)	-0.19 (0.22)	-0.22 (0.22)	-0.23 (0.23)	-0.10 (0.29)	-0.18 (0.21)	-0.20 (0.22)	-0.23 (0.22)
household income: more than 4000	-0.76*** (0.28)	-0.70** (0.32)	-0.04 (0.16)	-0.04 (0.16)	-0.07 (0.16)	-0.53** (0.26)	-0.58* (0.30)	-0.05 (0.15)	-0.04 (0.16)	-0.07 (0.16)
marital status: Other	-0.59 (0.42)	-0.49 (0.41)	-0.16 (0.28)	-0.26 (0.29)	-0.33 (0.29)	-0.47 (0.35)	-0.44 (0.40)	-0.17 (0.28)	-0.27 (0.29)	-0.33 (0.29)
marital status: Single	0.09 (0.20)	0.13 (0.22)	0.26* (0.14)	0.29* (0.15)	0.26* (0.15)	0.07 (0.19)	0.05 (0.21)	0.26* (0.14)	0.29* (0.15)	0.26* (0.15)
Criterion function	684.41					1351.92				
Num. obs.	600					600				
R ²		0.04	0.20	0.13	0.11		0.05	0.20	0.13	0.11
Adj. R ²		-0.02	0.16	0.08	0.07		-0.01	0.16	0.08	0.07
Num. obs.		600	600	600	600		600	600	600	600

C.3 Regression and Classification trees plot

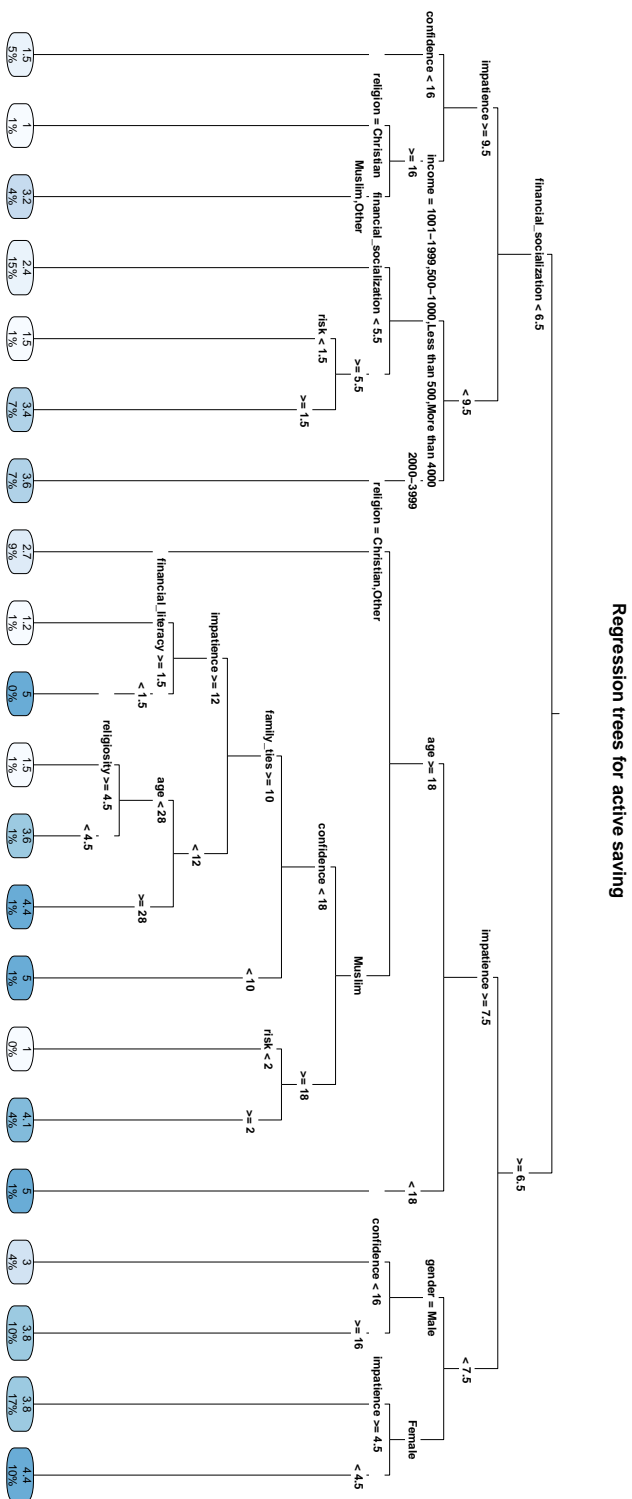


Figure C.9: Regression trees plot for active savings

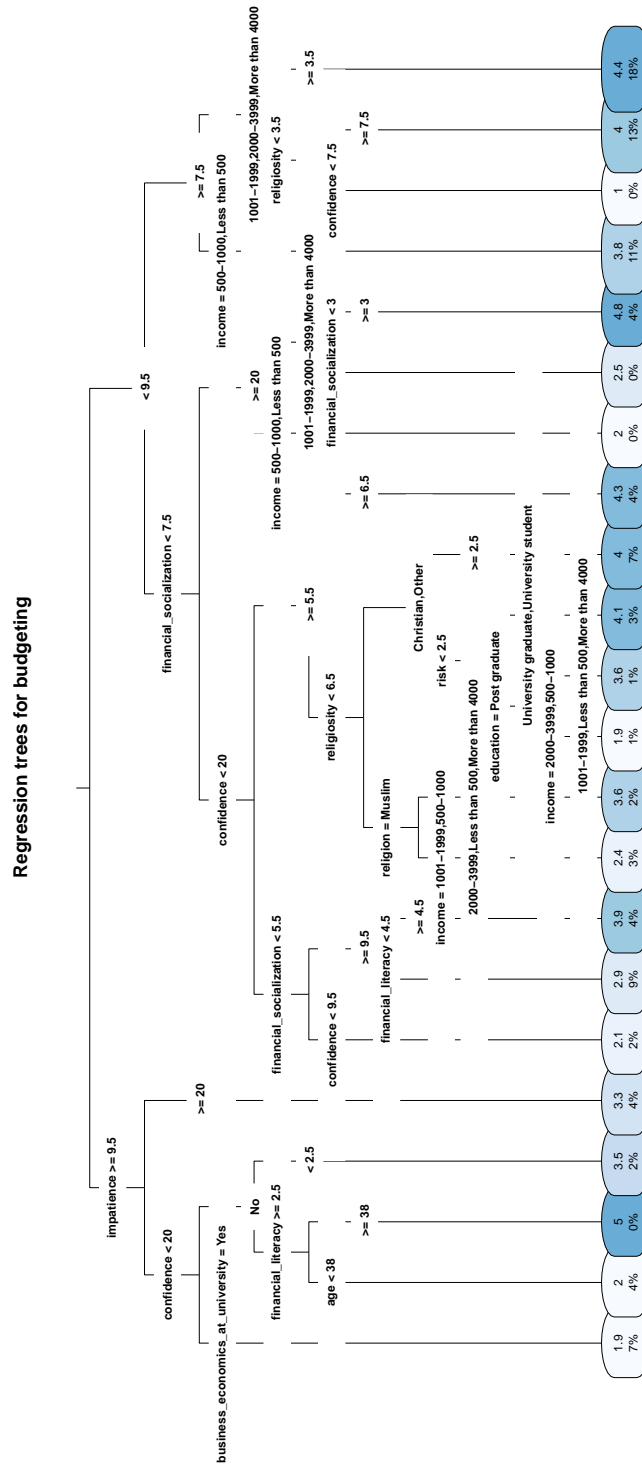


Figure C.10: Regression trees plot for budgeting

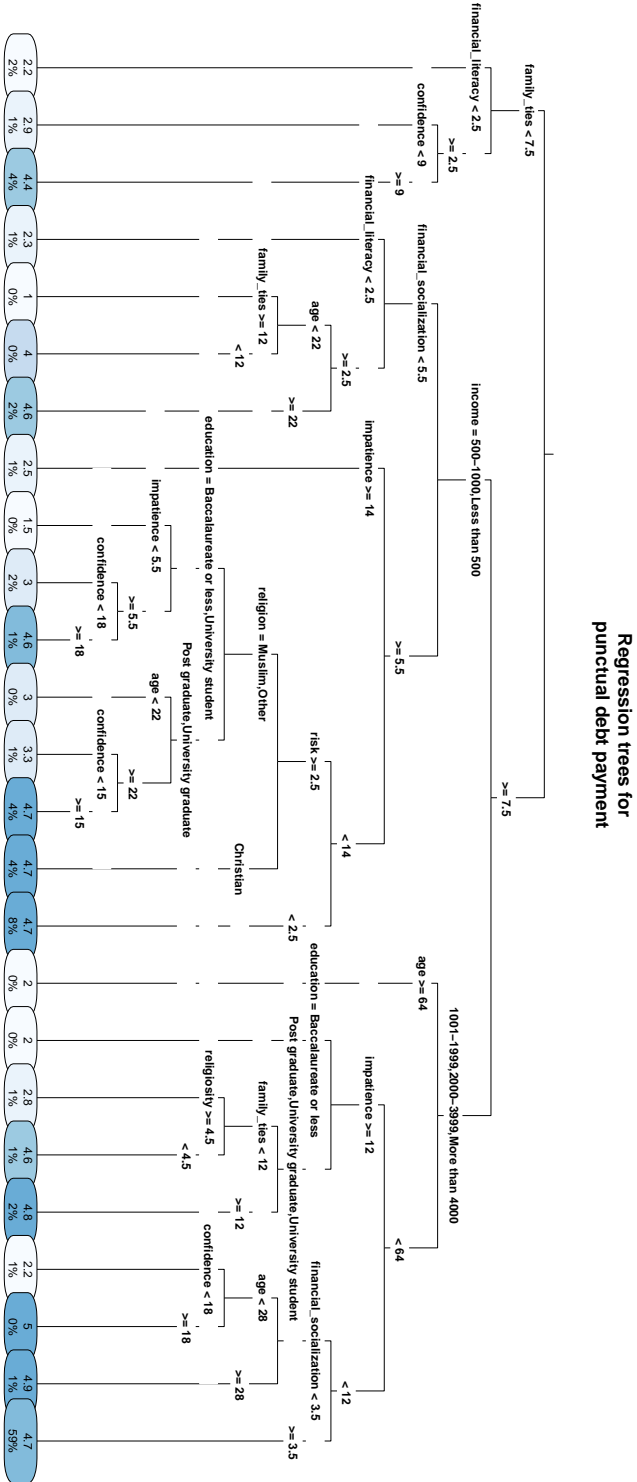


Figure C.11: Regression trees plot for punctual debt payment

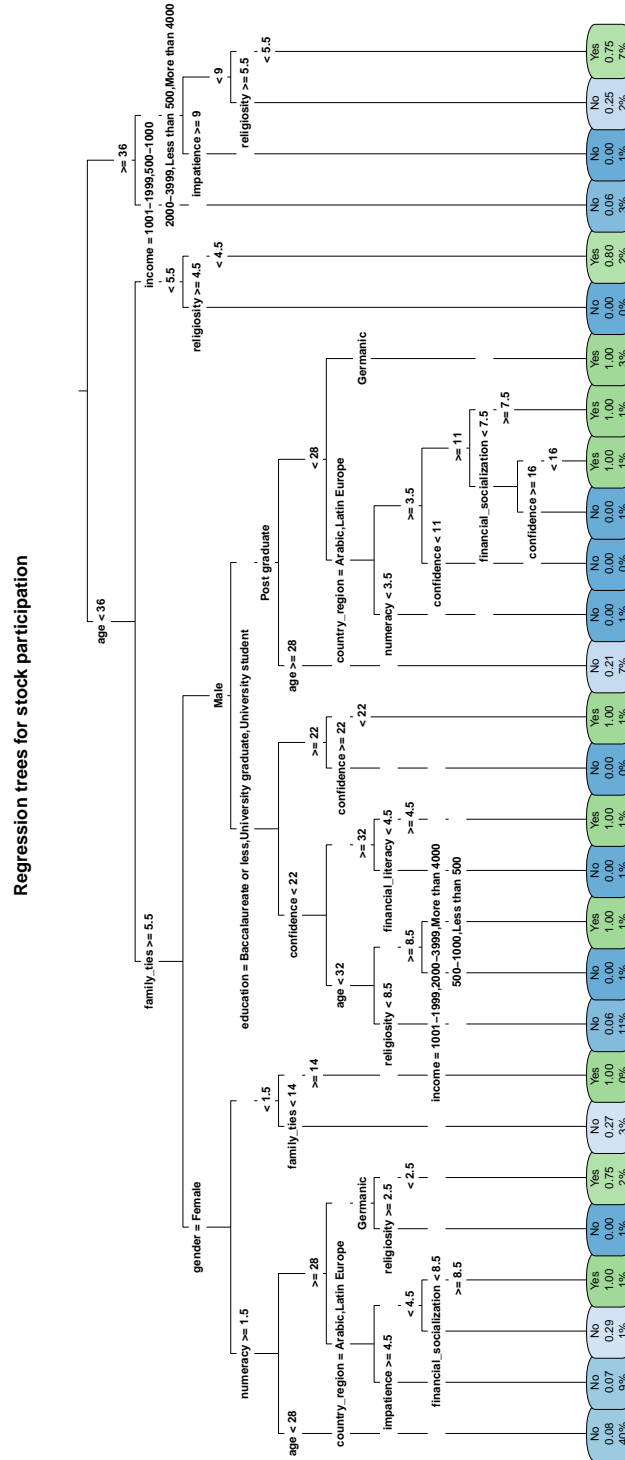


Figure C.12: Classification trees plot for stock participation

Appendix D

The Questionnaire

D.1 English Questionnaire

Dear user:

Ref: Measuring Determinants of Financial Literacy and Financial Behavior

In recent times, researchers have been emphasizing on financial literacy as an important determinant of financial behavior. The purpose of this survey is to examine your levels of financial literacy and financial behavior. Using the results of the survey, we aim at capturing cross cultural and psychological effects on financial literacy and financial behavior. We also hope to gain a better understanding of how financial education programs can be improved to better serve your financial behavior.

The success of this survey depends on your participation and frank responses. We would therefore greatly appreciate your assistance in answering the questionnaire. Please be assured that your responses will be kept strictly confidential. Individual participants will not be identified in the analysis as only aggregated results will be analyzed and presented.

In general, there are no right or wrong answers and the answers should only reflect the respondent's view or opinion. The questionnaire can be filled in less than 15 minutes. This questionnaire is an important part of a dissertation in fulfillment of the requirements for a PhD program in Management Sciences at the University of Minho to be done by Izzat Ramadan. If you have any queries, please do not hesitate to contact us by email at izzat.ramadan@liu.edu.lb.

Thank you for your participation

Regards,

Izzat Ramadan

Section 1

Please identify yourself with the following statements on a 5 point scale. 1=never, 2=seldom, 3=sometimes, 4=often, 5= always

1. My parents taught me how to budget and manage my pocket money.
2. My parents encouraged me to save money when I was between 12 and 16 years old.
3. When thinking of my financial investments, I am willing to take risks.
4. I have been actively saving for the future.
5. I have a budget in place to manage my payments and expenses.
6. I pay my fees and bills on time.
7. Over the past two years, I have been late in paying credit card bills, car, mortgage and other debt payments.
8. In my life, I have previously written a check to pay for an amount greater than what I got in my checking account.
9. I go to church, mosque or other place of worship.

Section 2

Please identify your level of agreement with the following statements on a 5 point scale. 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree.

10. I am confident in my ability to recognize a good financial investment.
11. I know what investments to look for to get the most return on my money.
12. I know the right questions to ask when making financial investment decisions.
13. I have the skills required to make proper financial investments.
14. I know the right tools sources such as friends, colleagues, financial advisers and media to consult to make wise financial decisions.
15. I am impulsive and tend to buy things even when I don't really need them.
16. I am impulsive and tend to buy things even when I can't really afford them.
17. I am prepared to spend money now and let the future take care of itself.
18. Financial services are complicated and confusing to me.
19. Taking financial education courses and seeking financial advice increases my financial knowledge which can help improve my income and financial well-being.
20. I am willing to spend money to take financial education courses and seek financial advising sessions to improve my financial knowledge and behavior.
21. I consider myself to be a religious person.
22. In my life, my family means everything to me.
23. One does not need to respect and love his or her undeserving parents.
24. Regardless of what the qualities and faults of one's parents are, one must always love and respect them.
25. Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children.
26. It is the parents' duty to do their best for their children even at the expense of their own well-being.
27. I don't like to have to do a lot of thinking.
28. I try to avoid situations that require thinking in depth about something.
29. I prefer to do something that challenges my thinking rather than something that requires little thought.
30. I prefer complex to simple problems.
31. Thinking hard and for a long time about something gives me satisfaction.

Section 3

Please answer with Yes or No.

32. Have you set aside emergency savings that would cover your expenses for 3 months, in case of sickness, job loss, economic downturn, or other emergencies?
33. Have you ever tried to figure out how much you need to save for retirement?
34. Have you ever opened a savings account?
35. Have you ever invested in government bonds?

36. Have you ever invested in individual stocks (shares) or mutual funds?
37. Do you currently have a savings account?

Section 4

Please select the appropriate box.

38. Suppose you have some money. Is it safer to put your money into one business or investment, or to put your money into multiple businesses or investments? a. One business or investment b. Multiple businesses or investments c. Don't know d. Refuse to answer
39. Suppose over the next 10 years the prices of the things you buy double. If your income also doubles, will you be able to: buy less than you can buy today, the same as you can buy today, or more than you can buy today? a. Less b. The same c. More d. Don't know e. Refuse to answer
40. Suppose you need to borrow 100 US dollars. Which is the lower amount to pay back: 105 US dollars or 100 US dollars plus three percent? a. 105 b. 100+3% c. Don't know d. Refuse to answer
41. At the age of 10, how did you perform in Maths compared to other children in your class? a. Much better b. Better c. Same d. Worse e. Much worse
42. The regular price of a shirt in Zara is 40 euros. How much will you pay for this Zara shirt if you get a sales discount of 35%? a. 5 b. 21 c. 26 d. 35 e. Don't know f. Refuse to answer
43. If a 500 ml of Head and Shoulders shampoo bottle costs 5 euros and a 750 ml of Head and Shoulders shampoo bottle costs 8 euros, which bottle will you buy if you only want to pay less for Head and Shoulders shampoo? a. 750 ml b. 500 ml c. Both are the same d. Don't know e. Refuse to answer
44. Suppose you put money in the bank for two years and the bank agrees to add 15 percent per year to your account. Will the bank: add more money to your account the second year than the bank did the first year, or will the bank add the same amount of money both years? a. More b. The same c. Don't know d. Refuse to answer
45. Suppose you had 100 US dollars in a savings account and the bank adds 10 percent per year to the account. How much money would you have in the account after five years if you did not remove any money from the account? a. More than 150 b. Exactly 150 c. Less than 150 d. Don't know e. Refuse to answer

Section 5

Demographics

46. Country (Lebanon, Syria, Portugal, Spain, Germany, Holland, Other)
47. Nationality (Lebanon, Syria, Portugal, Spain, Germany, Holland, Other)
48. Age
49. Gender
50. Marital Status (Single, Married, Other)
51. Native Language (Germanic, Arabic, Latin)
52. Second language (Germanic, Arabic, Latin)
53. Third language (Germanic, Arabic, Latin)
54. Education (high school or less, Bachelor, Post graduate)
55. Father's education (high school or less, Bachelor, Post graduate)

- 56. Mother's education (high school or less, Bachelor, Post graduate)
- 57. Religion (Muslim, Christian, Other)
- 58. University discipline (Business and Economics, Other)
- 59. Household income (less than 500, 500-1000,1001-1999,2000-3999,4000 and above)

D.2 Portuguese Questionnaire

Caro respondente:

Ref: Mensuração de Determinantes de Literacia Financeira e Comportamento Financeiro

Recentemente, a investigação tem vindo a enfatizar a literacia financeira como um determinante relevante no comportamento financeiro. O objetivo deste questionário é analisar a literacia financeira e comportamento financeiro do respondente. Com base nas respostas, espera-se contribuir para uma melhor compreensão de como os cursos de educação financeira podem melhorar o comportamento financeiro.

O sucesso deste questionário depende da sua participação e resposta franca. Agradecemos a sua participação. As suas respostas são estritamente confidenciais. Participações individuais não serão identificadas na análise e apenas resultados agregados serão analisados e apresentados.

Genericamente, não há respostas certas ou erradas e as respostas devem refletir a visão ou opinião do respondente. O preenchimento do questionário deverá demorar menos de 15 minutos. Este questionário insere-se no trabalho de Doutoramento em Ciências Empresariais da Universidade do Minho de Izzat Ramadan. Se tiver alguma questão, poderá contactar-nos através do email id5889@alunos.uminho.pt.

Obrigado pela sua participação

Cumprimentos,

Izzat Ramadan
Universidade do Minho
Braga, Portugal

Secção 1

Por favor, identifique o seu nível de concordância com as afirmações que se seguem numa escala em que 1=nunca; 2=raramente; 3=algumas vezes; 4=frequentemente e 5=sempre.

1. Os meus pais ensinaram-me a gerir a minha mesada.
2. Os meus pais encorajaram-me a poupar dinheiro quando tinha entre 12 e 16 anos.
3. Quando planeio os meus investimentos financeiros, estou disposto a assumir risco.
4. Eu tenho poupado ativamente para o futuro.
5. Tenho um orçamento para gerir os meus pagamentos e despesas.
6. Pago as minhas contas atempadamente.
7. Durante os últimos dois anos, atrasei-me a pagar cartões de crédito, contas relacionadas com o meu automóvel, hipotecas ou outras contas.
8. Já passei um cheque de um montante superior ao saldo que tinha disponível.

9. Frequento a igreja, mesquita ou outro local de culto religioso.

Secção 2

Por favor, indique o seu nível de concordância com as afirmações que se seguem numa escala em que 1=discordo fortemente; 2=discordo; 3=nem concordo nem discordo; 4= concordo; 5=concordo fortemente.

10. Sinto-me confiante em relação à minha capacidade de identificar bons investimentos financeiros.
11. Sei que investimentos procurar para obter o máximo retorno do meu dinheiro.
12. Sei quais as questões corretas a colocar quando estou a tomar decisões de investimento financeiro.
13. Eu possuo os conhecimentos necessários para fazer investimentos financeiros adequados.
14. Conheço fontes adequadas como amigos, consultores financeiros e meios de comunicação social a consultar para tomar decisões financeiras sensatas.
15. Eu sou impulsivo e tendo a comprar coisas mesmo quando não preciso realmente delas.
16. Eu sou impulsivo e tendo a comprar coisas mesmo quando não tenho capacidade financeira suficiente para as pagar.
17. Eu estou disposto a gastar dinheiro agora e deixar que o futuro se resolva sozinho.
18. Os serviços financeiros são complicados e confusos para mim.
19. Frequentar cursos em finanças e procurar aconselhamento financeiro, aumenta o meu conhecimento sobre finanças e pode melhorar o meu rendimento e bem-estar financeiro.
20. Estou disposto a gastar dinheiro na minha formação em finanças e a procurar aconselhamento financeiro para melhorar o meu conhecimento e o meu comportamento financeiro.
21. Considero-me uma pessoa religiosa.
22. Na minha vida, a minha família significa tudo para mim.
23. Não somos obrigados a respeitar e amar os pais se eles não forem merecedores.
24. Independentemente das qualidades e defeitos dos nossos pais, devemos amá-los e respeitá-los.
25. Os pais têm a sua vida própria e não devem sacrificar o seu bem-estar a favor dos filhos.
26. É dever dos pais fazer o melhor para os seus filhos mesmo à custa do seu bem-estar.
27. Não gosto de pensar muito.
28. Tento evitar situações que requerem pensar profundamente sobre um assunto.
29. Prefiro fazer algo que desafia as minhas capacidades intelectuais do que algo que requer pouco esforço intelectual.
30. Prefiro problemas complexos do que simples.
31. Fazer um grande esforço intelectual por um período prolongado dá-me satisfação.

Secção 3

Por favor, responda sim ou não.

32. Tem poupanças criadas com o objetivo de cobrir as suas despesas por 3 meses em caso de doença, desemprego, recessão económica ou outras emergências?
33. Já determinou o valor que precisa de poupar para a sua reforma?

34. Já alguma vez abriu uma conta de poupança?
35. Já alguma vez investiu em obrigações do tesouro?
36. Já alguma vez investiu em ações ou fundos de investimento?
37. Tem atualmente uma conta poupança?

Secção 4

Por favor selecione a resposta adequada.

38. Suponha que tem algum dinheiro disponível. Será mais seguro aplicar o dinheiro num negócio ou investimento ou aplicar o dinheiro em vários negócios ou investimentos? (Um negócio ou investimento, vários negócios ou investimentos, Não sei, Recuso-me a responder)
39. Suponha que nos próximos 10 anos os preços das coisas que compra duplicam. Se o seu rendimento também duplicar, será capaz de: comprar menos do que compra atualmente; comprar o mesmo que compra atualmente ou comprar mais do que compra atualmente? (Menos, O mesmo, Mais, Não sei, Recuso-me a responder)
40. Suponha que precisa de pedir 100 euros emprestados . Qual é o montante menor que poderia pagar: 105 euros ou os 100 euros mais três por cento. (105€, 100€ mais 3%, Não sei, Recuso-me a responder)
41. Aos dez anos de idade, como era o seu desempenho em matemática quando comparado com os seus colegas de turma? (Muito melhor, Melhor, Igual, Pior, Muito pior)
42. O preço normal de uma camisa na Zara é de 40€. Quanto irá pagar se a camisa ficar com 35% de desconto? (5€, 21€, 26€, 35€, Não sei, Recuso-me a responder)
43. Se uma embalagem de 500ml do champô H & S custar 5€ e uma de 750ml custar 8€, qual a embalagem que irá comprar se quiser comprar ao melhor preço? (500ml por 5€, 750ml por 8€, Ambas as embalagens são equivalentes, Não sei, Recuso-me a responder)
44. Suponha que coloca dinheiro numa aplicação financeira com duração de dois anos que paga juros anuais de 15 por cento. O banco no segundo ano irá pagar juros mais elevados do que no primeiro ou irá pagar o mesmo montante de juros no primeiro e no segundo ano. (Mais, O mesmo, Não sei, Recuso-me a responder)
45. Suponha que tem 100€ numa conta poupança e que o banco paga juros de 10 por cento ao ano. Quanto dinheiro teria na sua conta no fim de 5 anos, se não removesse qualquer valor da conta? (Mais do que 150€, Exatamente 150€, Menos do que 150€, Não sei, Recuso-me a responder)

Secção 5

Dados Demográficos

46. País (Portugal, Espanha, Alemanha, Holanda, Líbano, Síria, Outro)
47. Nacionalidade (Portugal, Espanha, Alemanha, Holanda, Líbano, Síria, Outro)
48. Idade
49. Género
50. Estado Civil (Solteiro, Casado, Outro)
51. Língua nativa (Latim, Germânica, Árabe, Outro)
52. Segunda língua (Latim, Germânica, Árabe, Outro)
53. Terceira língua (Latim, Germânica, Árabe, Outro)

54. Nível de educação (Bacharelato ou inferior, Licenciado, pós graduado)
55. Nível de educação do pai (Bacharelato ou inferior, Licenciado, pós graduado)
56. Nível de educação da mãe (Bacharelato ou inferior, Licenciado, pós graduado)
57. Religião (Cristã, Judaica, Muçulmana, Outro)
58. Curso universitário (Gestão e economia, Outro)
59. Qual o rendimento médio mensal do seu agregado familiar? (Menos de 500€, 500€-1000, 1001€-1999, 2000€-3999, Mais de 4000€)

D.3 Spanish Questionnaire

Estimado/a destinatario/a:

Ref: Medida de Determinantes de Cultura financiera y Comportamiento Financiero

Recientemente, las investigaciones han venido a enfatizar la cultura financiera como un determinante relevante en el comportamiento financiero. El objetivo de este cuestionario es analizar la cultura financiera y el comportamiento financiero del destinatario. En base a los resultados del cuestionario, se espera contribuir a una mayor comprensión de cómo los cursos destinados a educación financiera pueden mejorar el comportamiento financiero.

El éxito de este cuestionario depende de su participación y respuestas veraces. Quedamos muy agradecidos por su participación. Por favor asegúrese de no dar ningún dato personal (Nombre, Apellidos, D.N.I) que puedan comprometer la confidencialidad del mismo. No se identificará a ningún participante y sólo los resultados agregados serán analizados y presentados.

En general, no hay respuestas correctas o erróneas y las respuestas deben reflejar la visión o opinión del/la destinatario/a. La cumplimentación de este cuestionario deberá llevarnos menos de 15 minutos. Este cuestionario se incluye en el trabajo de Doctoramiento en Ciencias Empresariales de la Universidade do Minho de Izzat Ramadan. Si tuviese alguna duda, podrá contactar a través del correo electrónico: id5889@alunos.uminho.pt.

Gracias por su colaboración

Saludos,
Izzat Ramadan
Universidade Do Minho
Braga, Portugal

Sección 1

Por favor indique su nivel de acuerdo con las siguientes afirmaciones en una escala en la que 1=Nunca; 2=Raramente; 3= Algunas veces; 4= Frecuentemente y 5= Siempre.

1. Mis padres me enseñaron a administrar mi paga.
2. Mis padres me animaron a ahorrar cuando tenía entre 12 y 16 años.
3. Cuando planeo mis inversiones financieras, estoy dispuesta/o a asumir riesgos.
4. He estado ahorrando activamente para el futuro.
5. Cuento con un presupuesto para mis facturas y gastos.
6. Pago mis facturas/deudas a tiempo.

7. Durante los últimos dos años me retrasé en el pago de las facturas de tarjetas de crédito, letras del coche, hipotecas u otras facturas.
8. Alguna vez en mi vida he extendido un cheque por una cantidad mayor de lo que tenía en la cuenta.
9. Voy a la iglesia, mezquita u otro lugar de culto religioso.

Sección 2

Por favor indique su nivel de acuerdo con las siguientes afirmaciones en una escala en la que 1=Totalmente desacuerdo; 2= Deacuerdo; 3= Neutral; 4= De acuerdo y 5= Totalmente de acuerdo.

10. Estoy segura/o de mi habilidad para reconocer una buena inversión financiera.
11. Sé qué inversiones buscar para obtener el mayor beneficio con mi dinero.
12. Sé hacer las preguntas adecuadas cuando se trata de tomar decisiones financieras.
13. Poseo las habilidades requeridas para hacer inversiones financieras adecuadas.
14. Tengo conocimiento de las fuentes adecuadas, así como amigos/as, consejeros/as y medios de consulta para tomar decisiones financieras sensatas.
15. Soy impulsiva/o y tiendo a comprar cosas incluso cuando realmente no las necesito.
16. Soy impulsivo/a y tiendo a comprar cosas incluso cuando no tengo capacidad financiera suficiente para pagarlas.
17. Estoy dispuesto/a a gastar dinero ahora y dejar que el futuro se resuelva solo.
18. Los servicios financieros son complicados y confusos para mí.
19. Acudir a cursos sobre finanzas y buscar consejo financiero, aumenta mi conocimiento sobre finanzas y puede mejorar mi rendimiento y bienestar financiero.
20. Estoy dispuesto a gastar dinero en mi formación en finanzas y a buscar consejo financiero para mejorar mi conocimiento y comportamiento financieros.
21. Me considero una persona religiosa.
22. En mi vida, mi familia significa todo para mí.
23. Uno/a no está obligado a respetar y amar a sus padres si éstos no lo merecen.
24. Independientemente de las virtudes y defectos que los padres de uno/a tengan, uno/a siempre debe amarlos y respetarlos.
25. Los padres tienen su propia vida y no deben sacrificar su bienestar por el bien de sus hijos.
26. Es deber de los padres hacer lo mejor para sus hijos incluso a costa de su propio bienestar.
27. No me gusta tener que pensar mucho.
28. Intento evitar situaciones que requieren pensar profundamente sobre un asunto.
29. Prefiero hacer algo que desafíe mis capacidades intelectuales antes que algo que requiera poco esfuerzo intelectual.
30. Prefiero los problemas complejos antes que los simples.
31. Hacer un esfuerzo intelectual grande por un período prolongado de tiempo me da satisfacción.

Sección 3

Por favor, responda sí o no.

32. ¿Ha reservado ahorros que puedan cubrir sus gastos por tres meses, en caso de enfermedad, pérdida de empleo, revés económico, u otras emergencias?
33. ¿Ha tratado alguna vez de averiguar cuánto necesita ahorrar para su jubilación?
34. ¿Ha abierto alguna vez una cuenta de ahorro?
35. ¿Ha invertido alguna vez en bonos del Estado?
36. ¿Ha invertido alguna vez en acciones o fondos de inversión?
37. ¿Tiene actualmente una cuenta de ahorro?

Sección 4

Por favor elija la respuesta adecuada.

38. Suponga que tiene algún dinero disponible. ¿Será más seguro usar su dinero en un negocio o inversión, o en varios negocios o inversiones? (Un negocio o inversión, Varios negocios o inversiones, No sé, No contesto)
39. Suponga que dentro de 10 años los precios de las cosas que compra se duplican. Si sus ingresos también se duplican será capaz de: ¿Comprar menos de lo que compra actualmente; comprar lo mismo que compra actualmente o comprar más de lo que compra actualmente? (Menos, Lo mismo, Más, No sé, No contesto)
40. Suponga que necesita 100 euros prestados. ¿Cuál sería el importe menor que podría pagar: 105 euros o 100 euros más el 3 por ciento? (105€, 100€ más el 3%, No sé, No contesto)
41. ¿A la edad de 10 años, cómo era su desenvolvimiento en matemáticas comparado con sus compañeros/as de clase? (Mucho mejor, Mejor, Igual, Peor, Mucho peor)
42. El precio normal de una camiseta de Zara es de 40 €. ¿Cuánto pagará si la camisa se queda con un 35% de descuento? (5€, 21€, 26€, 35€, No sé, No contesto)
43. Si un bote de 500 ml de champú H & S cuesta 5€ y uno de 750 ml cuesta 8€, ¿qué bote compraría si sólo quiere pagar menos por el bote de champú? (500ml por 5€, 750ml por 8€, Los dos botes cuestan lo mismo, No sé, No contesto)
44. Suponga que deposita dinero en un producto financiero con duración de 2 años que paga intereses anuales de un 15%. ¿Añadirá el banco más dinero a tu cuenta el segundo año del que añadió el primer año, o añadirá el banco el mismo importe ambos años? (Más, El mismo, No sé, No contesto)
45. Suponga que tiene 100 € en una cuenta de ahorro y que el banco paga intereses del 10% anual. ¿Cuánto dinero tendría en su cuenta al cabo de 5 años, si no retirase dinero alguno de la cuenta? (Más de 150€, Exactamente 150€, Menos de 150€, No sé, No contexto)

Sección 5

Datos Demográficos

46. País (Portugal, España, Alemania, Holanda, Líbano, Siria, Otro)
47. Nacionalidade (Portugal, Espanha, Alemanha, Holanda, Líbano, Siria, Otro)
48. Edade
49. Género
50. Estado Civil (Soltero/a, Casado/a, Otro)
51. Lengua nativa (Latina, Germánica, Árabe, Otro)

52. Segunda lengua (Latina, Germânica, Árabe, Otro)
53. Tercera lengua (Latina, Germânica, Árabe, Otro)
54. Nivel de educación (Bachiller o inferior, Licenciado/a, Postgrado)
55. Nivel educativo del padre (Bachiller o inferior, Licenciado/a, Postgrado)
56. Nivel educativo de la madre (Bachiller o inferior, Licenciado/a, Postgrado)
57. Religión (Cristiana, Judía, Musulmana, Otro)
58. Especialidad universitaria (Economía y gestión, Otro)
59. ¿Cuál es el ingreso medio mensual del núcleo familiar? (Menos de 500€, 500€-1000, 1001€-1999, 2000€-3999, Mais de 4000€)

